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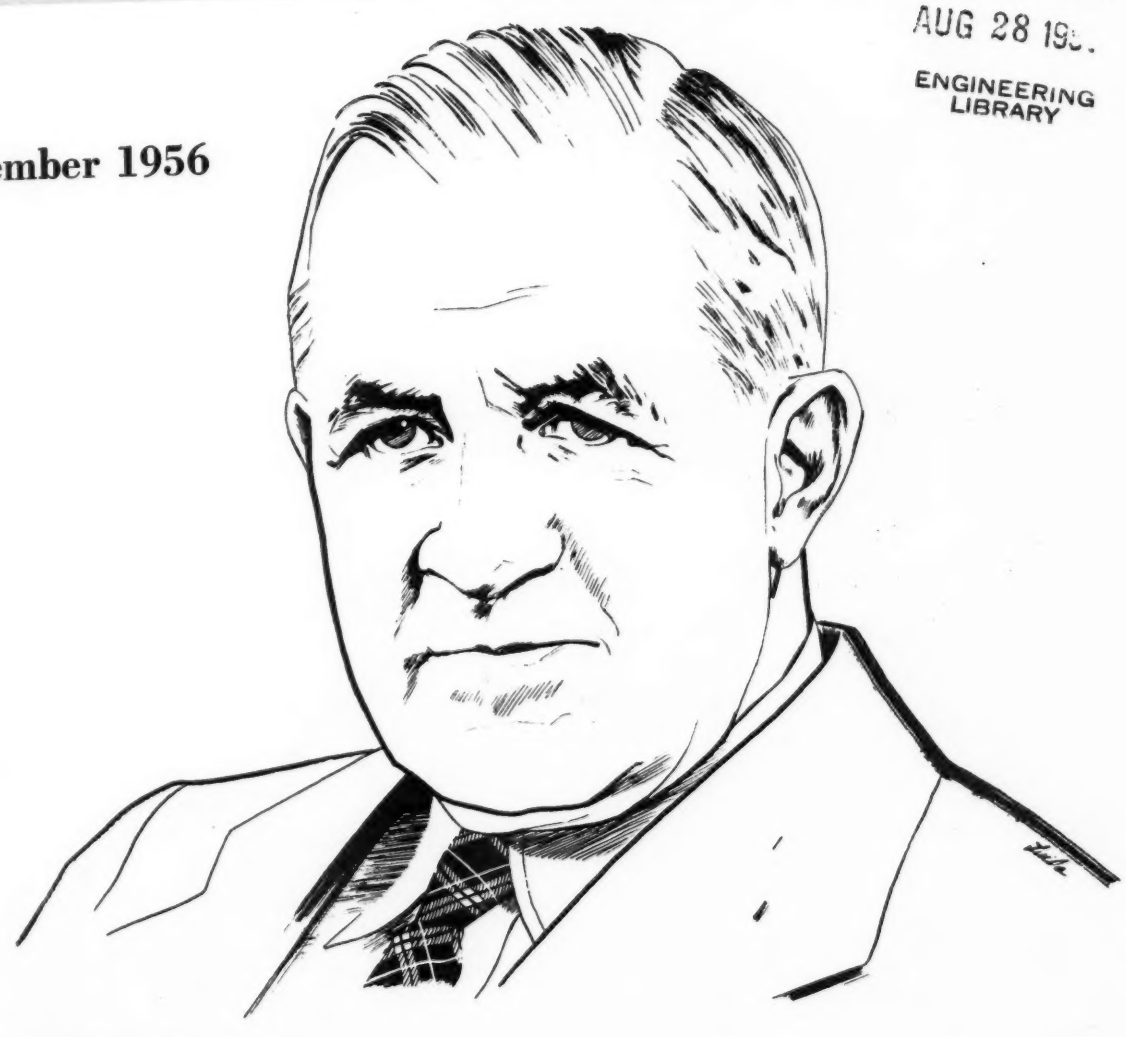

Intrigued by Economics

J. B. MORROW, Consulting Engineer, of Pittsburgh, Pa., member of the American Institute of Consulting Engineers, Director of the National Coal Association from 1941 to 1951, and Vice President and Director of The American Institute of Mining and Metallurgical Engineers from 1952 to 1955, has been an expert on techniques of coal mining for over 40 years. He is the recipient of the Percy Nicholls Award from AIME and ASME, the Erskine Ramsay

—*Continued on page 6*

The Consulting Engineer's Professional Magazine

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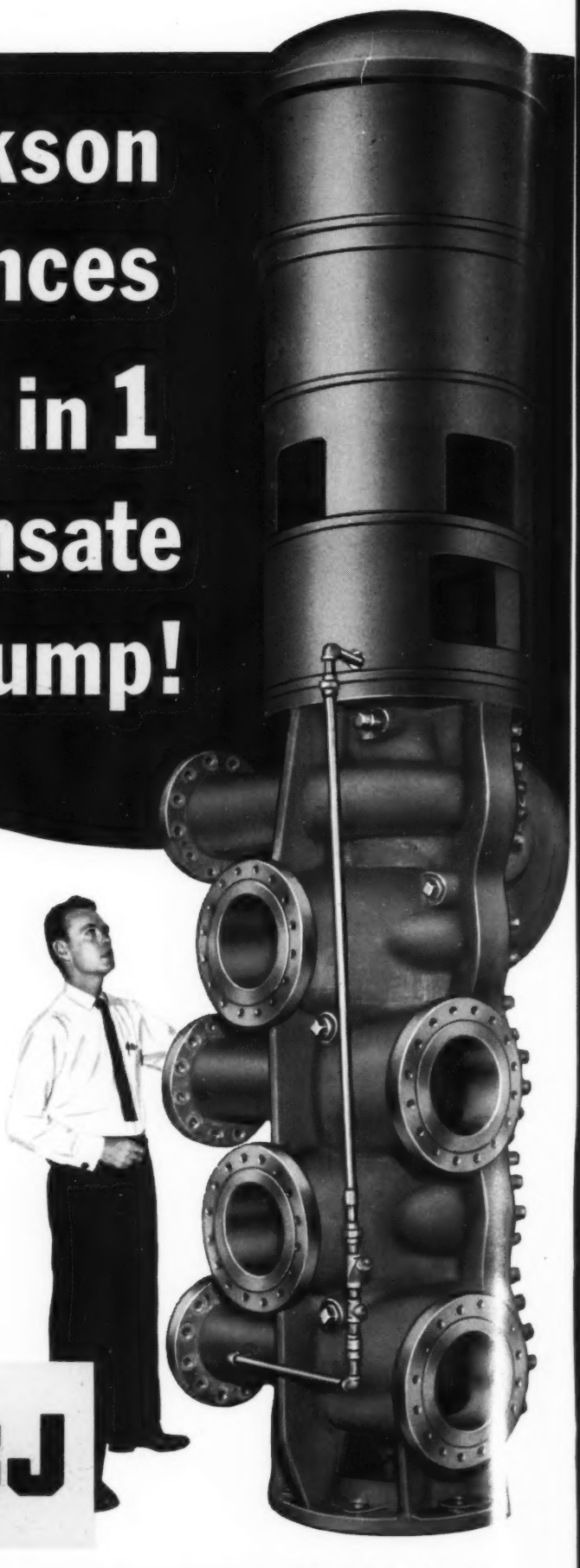

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Consulting Engineer®

September 1956

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The Consulting Engineer's Professional Magazine

J. B. Morrow

—Starts on front cover

Gold Medal from AIME, and the Bituminous Coal Research Award.

In Pittsburgh, Morrow's name is synonymous with mining. He first came to Pittsburgh as a consulting engineer to the Pittsburgh Coal Company, in 1927. He had had experience with coal preparation plants with Phelps Dodge Corp. at Dawson, New Mexico, where many ideas common to ore dressing practice were first used on coal preparation. Morrow, although engaged for a 60-day consulting job, stayed on to help operate the three new plants, as Preparation Manager. In 1935 he was made operating Vice President, and in 1940, President. In 1948 he became Chairman of the Board, the position from which he retired in 1951. From 1946 to 1951 he served also as First Vice President of Pittsburgh Consolidation Coal Company.

Educated at the Dalhousie School of Mines, in Halifax, Nova Scotia, Morrow started his mining career as an assayist in Cobalt, Ontario during the big silver strike. When the silver fever abated, he moved down to New Mexico where he worked in lead and copper smelters, as he says, "At the business end of a shovel." When a job as chemist at the Stag Canyon Branch of Phelps Dodge copper smelter opened up, Morrow took the job and moved up from Chemist, to Coke Superintendent, to General Superintendent.

With this extensive experience in the mining industry—both as an industrial executive and now as a consulting engineer—he is convinced that an operating company cannot divorce its management and engineering activities.

"As an engineer taking over management duties I was impressed with the tremendous importance of the financial aspect of running such a company," Morrow comments. "In 1938, when I became an officer in a coal company, engineering and management activities were strictly divided. The engineering heads were seldom trained to take over as management. At that time young engineers were hired by industry and sometimes lost in routine work. Gradually this situation has changed so that now the young engineer is moved about in the company to learn many different skills and the financial aspects of the business. I wonder if the shortage of engineers isn't really a shortage of technicians. Technical employees could take over much of the routine work in industry releasing the engineer for training in the broader aspects of his company's operation or to go into private practice.

"I was so intrigued by the economics of mining that I have based my consulting business on providing economic studies for my clients. My office also engages in inspection of properties, evaluations of equipment and personnel, and forecasts. During the three years that Newell G. Alford and I engaged in consulting work under the name of Alford, Morrow and Associates (1952-55), we took on design work but my major interest now is the economics of mining.

"As close as I have been to the coal industry, it is amusing to see the 'scare' forecasts that are published from time to time on how soon this country will run out of coal. I made a survey myself in which I used the lowest estimate of coal reserves and the highest estimated figures for gas and oil, based on Btu's available. On this basis, coal accounts for 64 percent of all mineral fuel reserves, gas and oil each account for only 18 percent. Our problem is that large untapped coal reserves are in Wyoming, Montana, Utah, and up into Alberta, Canada, where they are too far from markets. Oil shale is just as far away. Work is going on now to find an efficient, cheap way to gasify this western coal.

"The railroads were the largest users of coal before diesels replaced the steam engine. The coal fired gas turbine, now in the design stage, will give the diesel a run for its money, since coal is still so much cheaper than oil.

"If electric power keeps doubling every ten years, as it is now doing, power companies will be the major users of coal. Last year they used 140 million tons. Right now the power companies are buying up coal reserves. The iron and steel industries also have taken up some of the slack caused by the use of diesel engines.

"The present availability of low cost Btu's from coal in the Mississippi and Ohio River valleys, coupled with low cost water transportation, indicate that this area will be a major center for the electrometallurgical industry in the next five to ten years. Aluminum is now moving in and titanium should be expected to follow, as well as other types of industrial processes using large amounts of power as a component of the final product.

"Completion of the St. Lawrence Seaway will accentuate this trend and it should be noted that the proposed canal from Beaver Falls, Pa. to Lake Erie would bring iron ore from Labrador to Pittsburgh.

"Bituminous Coal Research, Inc., of which I was president from 1948 to 1950, is currently spending about $1/2 million a year on research aimed at ways to use coal more efficiently, as well as to promote new uses such as liquid fuels and chemicals from coal. While the amounts expended are entirely inadequate for the real needs of the industry, particularly for fundamental research, at least it does indicate some progress in industry thinking.

"As far as I can see there is no danger of a scarcity of coal for general industrial use and all indications point to an expanding market, particularly for power generation." ▲▲

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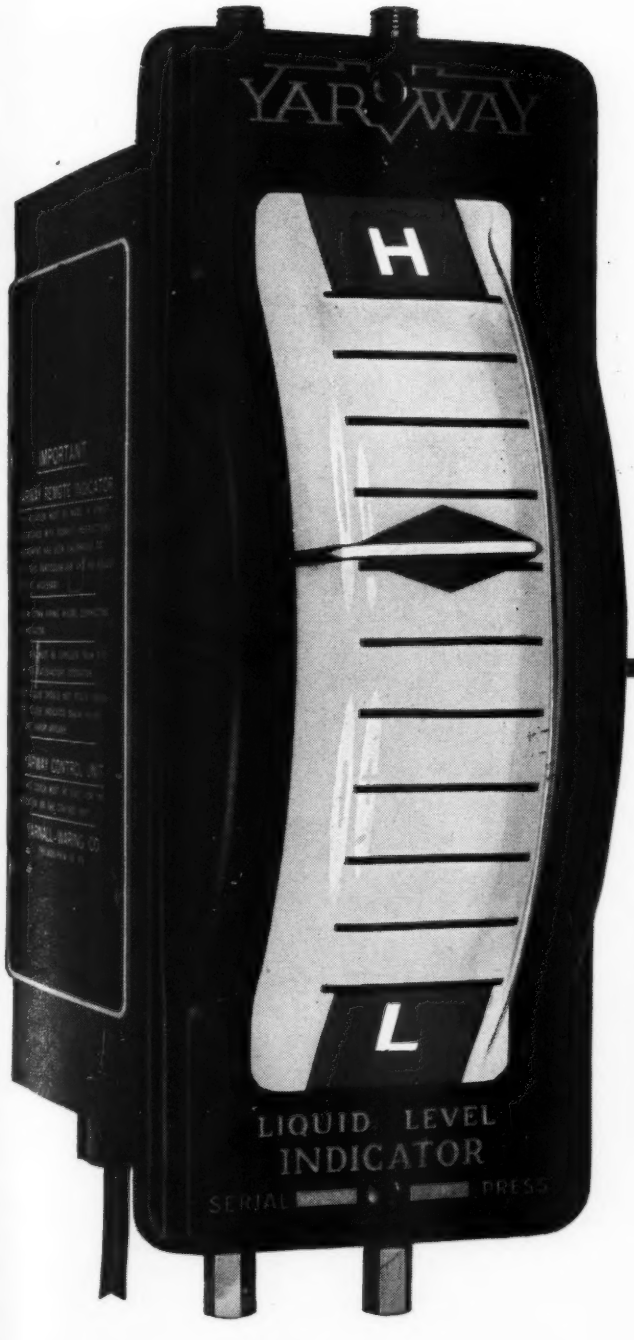

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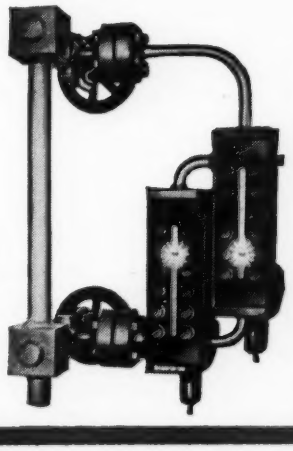

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READERS' COMMENT

Responsibility

Sir:

I read with great interest your article regarding engineers who offer their services to the public ("Scraps & Shavings," June '56). I have been offering my services to the public since 1927 and have never refused to consider any project regardless of size . . . in my category.

May 1954, I received an order to make a drawing of a radio tower. I prepared a drawing for a new tower which was correct in design. This drawing was approved by the City of Baltimore (W. R. Suda registered engineer in New York and Maryland) and by the C. A. A. The owner obtained a permit for a new tower.

The owner purchased an old tower with the same type of sections, which had been taken down from the top of a frame hotel building in Montrose, Pa. during a snow storm and hauled 250 miles, stored, and later erected without any inspection. During the construction the tower failed.

The owner brought suit against me and obtained a jury verdict of $4700.00. An appeal for the case was refused because I could not furnish any new evidence that could not have been obtained by reasonable care.

Record of this case is:

Diamond Cab vs Henry Hagel. Superior Court Docket 1954, Page 1009 File No. 26181. Wase & Witman represented the defendant.

The building code for the City of Baltimore requires that all radio towers must be tested and inspected by an independent testing and inspection laboratory who have no interest in the design, erection, material, or purchase of the tower. It further requires that the supervision of the erection be done by a registered engineer, preferably the one who designed the structure. The designer, however, has no authority to force his employment on the owner . . .

The damaging statement was made by W. R. Suda when he answered "No" to the question, "Was the drawing a complete working drawing?" The drawing was not a detail drawing, but according to common practice it is a complete engineer's working drawing.

This is a case where an engineer is held accountable by the courts for something he had no authority to prevent. This case as a precedent will effect every practicing engineer.

Henry Hagel
Consulting Structural Engineer
Baltimore, Md.

Looking

Sir:

Your recent staff report "Consultants Can Hire the Men They Need" (May 1956) . . . was of considerable interest to me. It brings to mind a personal problem which I realize must be confronting hundreds of other young engineers throughout the country. The big question is, just what does the engineer in his late thirties or early forties, who has progressed past the level of technician, do to better himself when the only foreseeable future in his own concern is a ten to fifteen year wait until the top executive positions are opened by death or retirement.

For an example, let me review my own case. I am [over 30] and have worked for the same consulting firm for over 10 years, primarily on bridges, railroad relocation, and highway work. Prior to this job I spent 4½ years as an officer in the Naval Reserve during World War II. As I entered the service immediately upon receiving my degree in civil engineering . . . you can see that my present employer is the only one I have ever had. In the ten years with this company I have risen steadily and, by some standards

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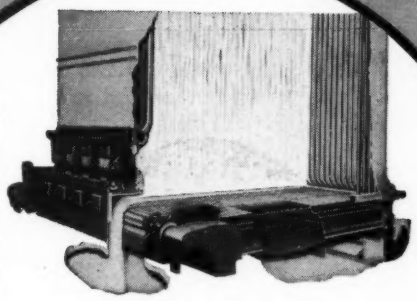

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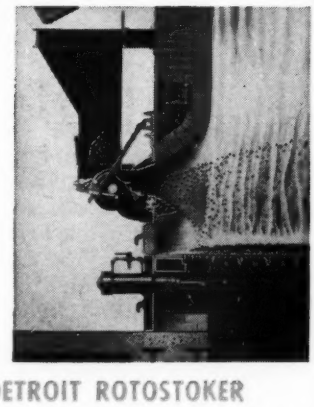

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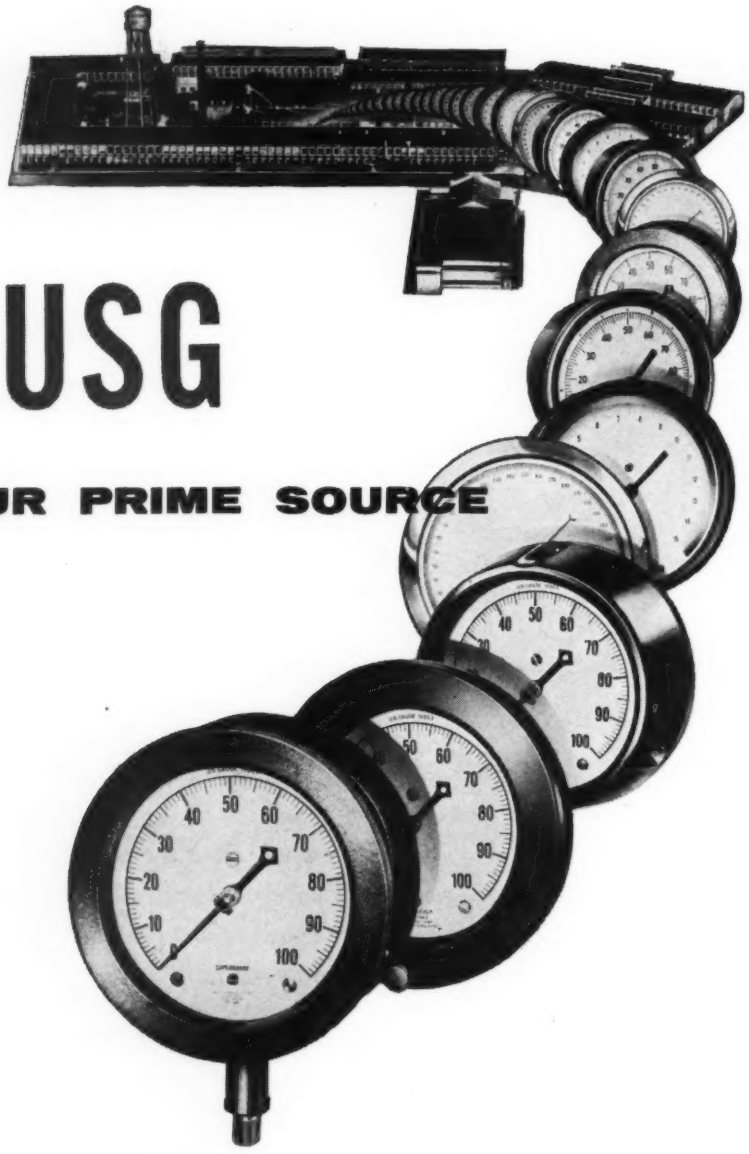

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rapidly, to what appears to be a plateau of minor administrative level, passing on my way several engineers who have been with the same company 15 to 20 years . . .

The big demand in our field today is for the technician, the designer, and experienced draftsmen, and frankly I have been away from design long enough that I could not justify my present salary as a technician and I would hesitate to take a cut just for the sake of gambling on a possible future which in reality may not be as bright as the one I see right now.

Your magazine article indicates how consultants can hire the men they need but how can a man find the consultant he is looking for?

(Name Withheld)

August Personality

Dear Sir:

Thank you for your letter of July 31st enclosing a copy of your August issue which features my picture on the cover. The sketch your artist made of me is a very good likeness.

H. J. Petersen
United Engineers & Constructors, Inc.
Philadelphia, Pa.

Those Missing Issues

Dear Sir:

All issues of CONSULTING ENGINEER have been placed in my permanent reference file since I received my first copy in 1952. Unfortunately some issues have become misplaced.

Will it be possible for me to secure copies of the following issues: Jan. '53 and Feb. '53. My desire is to retain a complete file on the publication. I have had copies for 1954 and 1955 permanently bound. Incidentally, my earliest copy is December 1952. Is that the first issue?

Hueston M. Smith, President
Smith-Hanlon-Zurheide-Levy, Inc.
St. Louis, Mo.

• THE DEC. '52 ISSUE WAS A PILOT RUN. REGULAR PUBLICATION BEGAN IN MARCH '53.

Food Engineering

Dear Sir:

You may be interested in knowing that the "Specialized Field — Food Facilities Engineering" article you published in the June issue of CONSULTING ENGINEER has already brought results. Architects and engineers have written me asking for names of F.F.E.S. members from whom they can request assistance on food facilities engineering.

N. Bert Persson
Food Service Equipment Engineering
St. Paul, Minn.

The Reader's Guide

So Big

If you have a client who is about to build a new plant, one of the first problems the two of you have to agree upon is size. Naturally, the new plant should be large enough to take care of current capacity, but if the business is growing, how much space should be added to take care of expected growth? Is it better to build now only the plant volume actually needed and add to the building later as the demand arises? Or is it more economical to go ahead and build the larger plant now and let part of it sit idle until such time as the space is needed? Any decision involving future needs is bound to involve some star gazing, but the cost comparison need not be pure guesswork. In an article in this issue, H. B. Backenstoss, Jackson & Moreland, offers some formulas that will give you something more than a hopeful guess to guide you and your client in making the decision.

Engineering Education

According to Thomas Hughes, a graduate mechanical engineer and a professor of history at Washington and Lee University, engineering is a young profession. It was not until the 19th century that the principles of pure science were combined with the work of the technician and inventor to produce the professional engineer. In an article in this issue, Dr. Hughes gives a glimpse of conditions in England in mid-19th century, a time at which there was a great and important discussion as to the kind of education the engineer should have and the kind of work he should do.

A Place in the Sun

Where do we now stand on the application of Solar Energy? Is the use of the heat from the sun still experimental, or are there instances now where consulting engineers might find it possible to specify solar units for heating or evaporation? Since there are a number of commercial installations already in operation, it is time the U.S. consultant knew more about the subject. E. A. Farber and J. C. Reed, of the University of Florida, have been doing some interesting research on solar energy, and in an article in this issue, they give examples of their work and tell something of the current state of the science.

World Bank Notes

A lot of foreign projects are financed through the World Bank and its agencies. Foreign consultants are conscious of the influence of this organization in setting up these projects and determining who does the engineering and supervision of construction. At a luncheon we attended in Paris, one French engineer had to leave early to catch a plane to Washington and keep an appointment at the Bank. U.S. engineers, with some few exceptions, are unconscious of the amount of profitable professional work these World Bank projects represent. This lack of information will be overcome soon. We are at work on an article that will tell how the World Bank functions and how it influences the selection of the engineers used on the projects they finance.

Profit Abroad

More and more U.S. consultants are finding profitable projects abroad. From time to time, we have published articles telling of their experiences and the type of work they have been able to do most successfully. Paul Weir Co., of Chicago, has been at work for several years on a most interesting mining project in Turkey. One of their engineers on the job, John E. Good, and Asaf Yenisey, of a Turkish government agency, have written for us an article published in this issue that tells what is being done on this project and the prospects for increased industrial growth for Turkey as a result of this work. The scope of the job gives an idea of the kind of work waiting for American consultants who are able and willing to take on foreign assignments.

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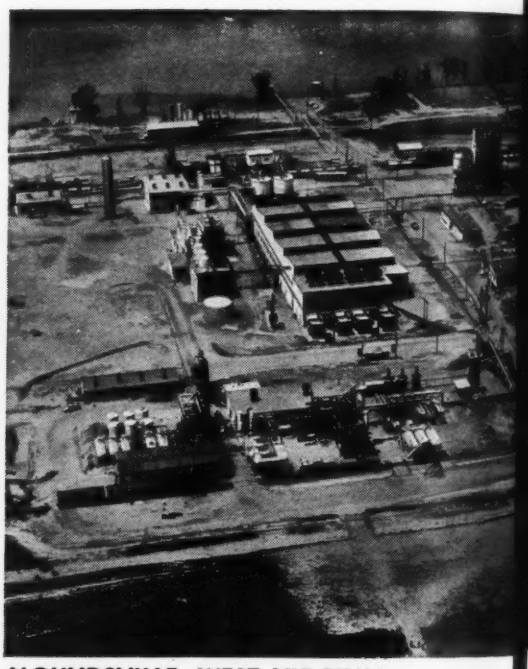

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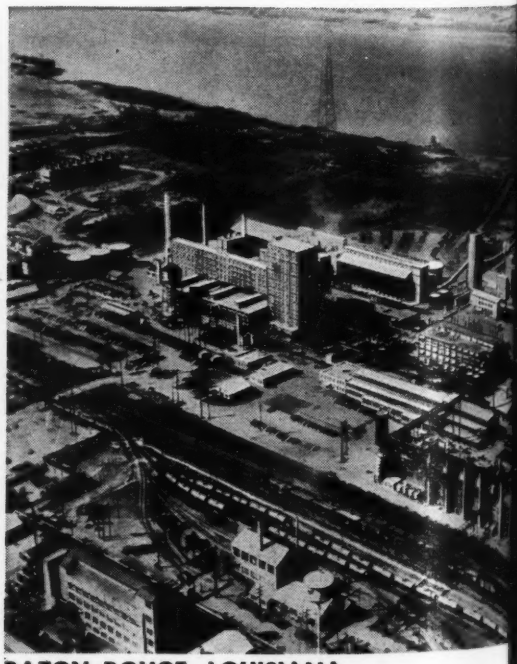
SYRACUSE, NEW YORK



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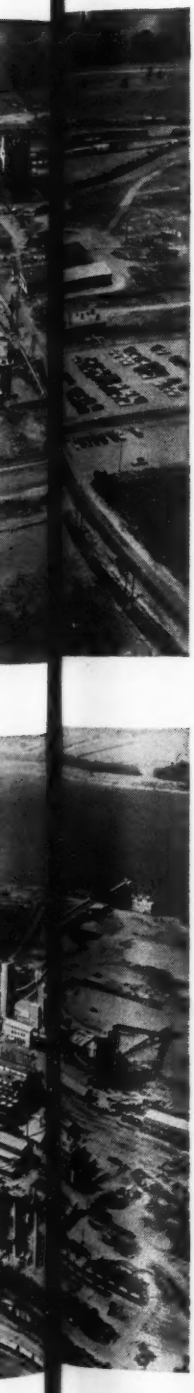

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Scraps & Shavings

ACCORDING TO A NEWS STORY in the July issue of *Civil Engineering,* "Evidence has been brought to the attention of the Board of Direction and the Committee on Professional Conduct of greatly increased activity on the part of commission agents offering to secure projects for engineering firms." The Board of Direction of A.S.C.E. thereupon stated that this is in violation of Item 9 of the Code of Ethics of the Society.

Indeed it is! Item 9 states that it is unethical "to use undue influence or offer commissions or otherwise to solicit professional work improperly, directly, or indirectly."

This is not the first time the American Society of Civil Engineers has faced a problem of this nature. Just about three years ago they caught several of their members sending in sealed bids — competing on a price basis — in connection with a bridge project in South Carolina. The Board of Direction took a dim view of this type of activity, finding it in conflict with Article 4 of the Code of Ethics, which at that time was opposed to "competitive bidding on a price basis to secure a professional engagement." Therefore, the Board tossed a few guilty members out of the Society and suspended several others.

This must have been a very difficult and embarrassing action for the Board of Direction, and happily, they will not have to face it again. The solution was quite simple. They changed the Code of Ethics. Now, a new Article 4, approved by 12,443 out of 14,043 ballots counted, permits competitive bidding on a price basis, providing there are reasonable grounds for belief that price will not be the *prime* consideration.

In other words, if members do not act in accordance with the rules, change the rules to fit the actions of the members.

With this kind of precedent, we cannot see why the Board of Direction or the Committee on Professional Conduct should be worried about influence peddlers. The course of action is obvious. First, act upon the evidence presented to the Board and identify the members who are paying commission agents for securing projects. Throw two or three of these members out of the Society and suspend those who have just a few commission agents on their payroll or those who pay just small commissions. Then revise Item 9 of the Code of Ethics as follows:

> "It shall be considered unprofessional and inconsistent with honorable and dignified bearing for any member of the American Society of Civil Engineers to use influence or offer commissions or otherwise to solicit professional work improperly, directly or indirectly *when there are reasonable grounds for belief that such influence, commissions, or other improper solicitation will be the prime consideration in the selection of the engineer.*"

This amendment could then be referred to the entire membership, about 11 percent of whom are in private practice, and the amendment would, without question, be approved by a vote of at least 12,000 out of 14,000 ballots.

Then, there would only be eight more Items in the Code of Ethics to be similarly handled, and these could be taken in turn as the need arises.

IT IS REALLY A VERY SERIOUS GAME — SO WE MAKE UP THE RULES TO FIT THE OCCASION.

HOW TO CUT POWER DISTRIBUTION COSTS 15 TO 25%

Investigate the benefits of aluminum bus duct—new from Westinghouse. Because it's aluminum you save from 15 to 25% in initial cost.

The same top quality and performance, heretofore obtainable only with copper, is guaranteed—thanks to the new electroplating process which Westinghouse uses to eliminate the dangers of high-resistance splices for all time.

Initial cost savings are not the only benefits. This duct handles and installs faster because it's as much as 35% lighter. And it's prefabricated in many standard shapes, allowing you complete design freedom. Call or write today to Westinghouse, Box 868, Pittsburgh 30, Pennsylvania, for the new book about aluminum bus duct, the modern way to distribute power, B-7003. J-30221

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I-T-E CURRENT-LIMITING "CORDON" Circuit Breakers

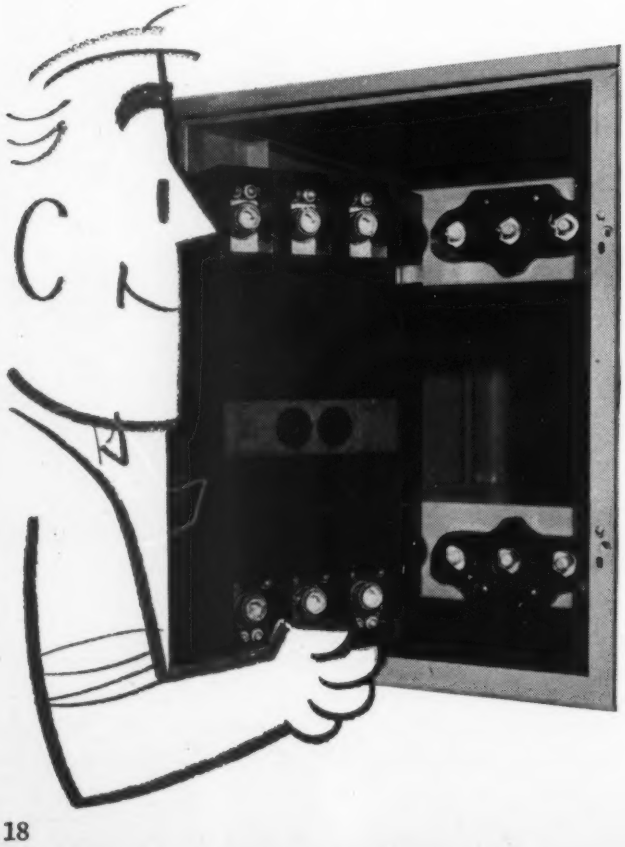
limit short circuit currents of high magnitude to a fraction of their possible value

"Cordon" Circuit Breakers combine current-limiting Amp-Traps* with standard thermal-magnetic molded case circuit breakers in a compact, integral design. They safely protect circuits where fault currents may reach 100,000 rms amperes, and also protect against sustained overloads and low magnitude short circuits. These current-limiting circuit breakers are now available as follows:

- A complete line—four frame sizes, 100, 225, 400 and 600 amp; 250 v d-c, 600 v a-c—with interrupting rating of 100,000 rms amperes
- With NEMA 1A and NEMA 12 enclosures
- With plug-in mounting for switchboard applications

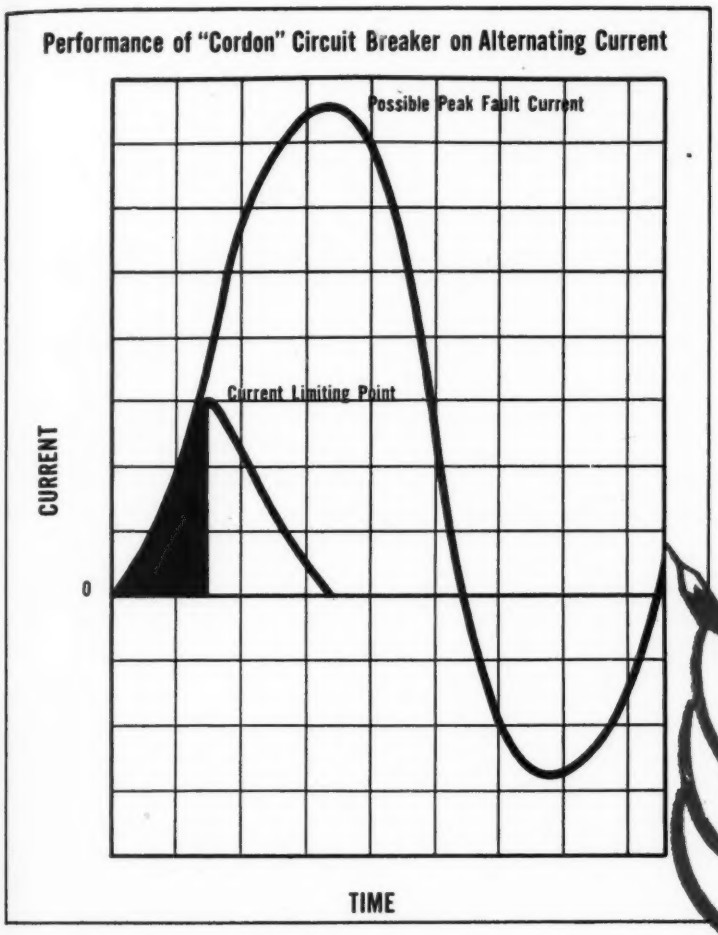
For complete information, contact your I-T-E representative. Or write I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Phila. 30, Pa.

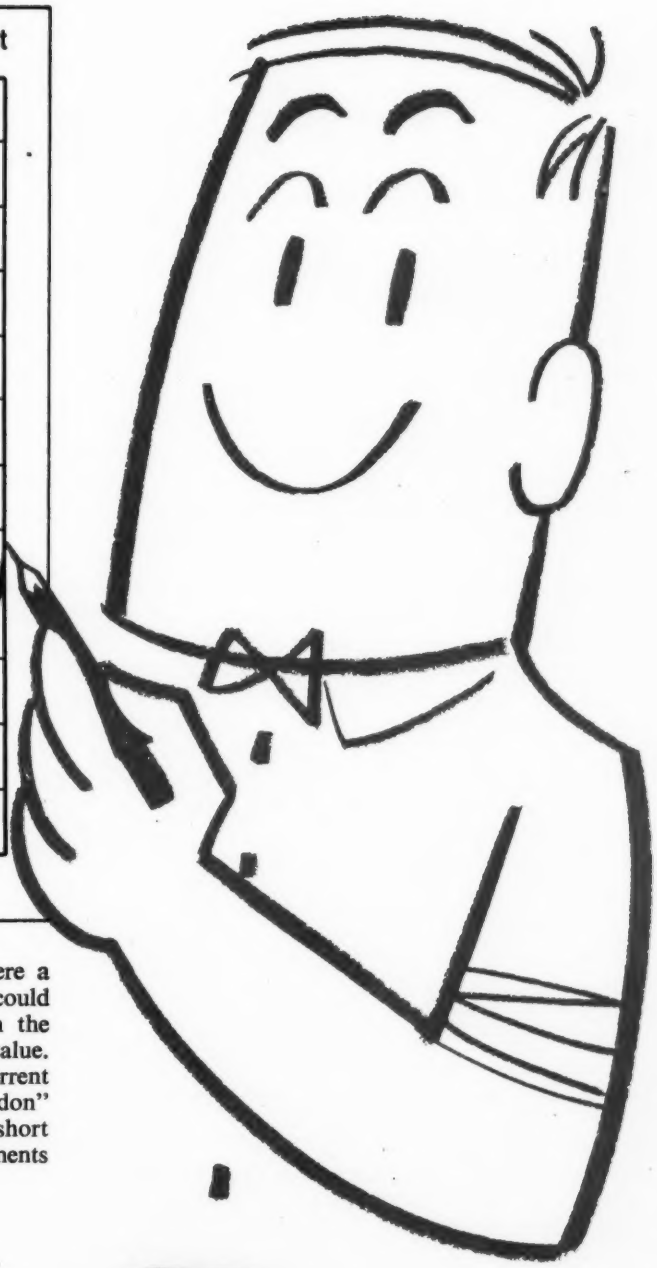
**Amp-Trap is a registered trade-mark of the Chase-Shawmut Co.*



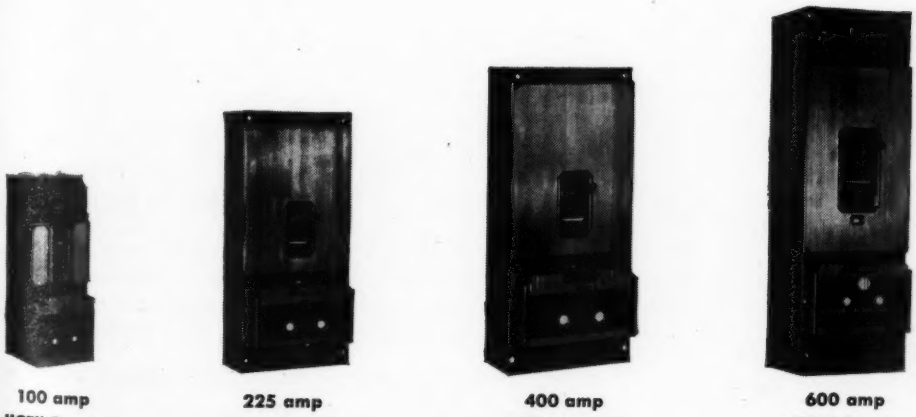
NEMA 1A AND NEMA 12 ENCLOSURES for housing "Cordon" Circuit Breakers are available.

FLEXIBILITY WITH PLUG-IN MOUNTING. Withdraw the breaker, insert another of the same frame size with the desired continuous ampere rating. No wiring changes. All "Cordon" Circuit Breakers can be supplied with plug-in mounting arrangement.





100,000 RMS AMPERE PROTECTION. On a circuit where a 100,000 rms ampere fault current is possible, the peak current could rise to approximately 190,000 amperes. With a "Cordon" in the circuit, the peak current is limited to a fraction of its possible value. The speed of the current-limiting Amp-Traps prevents the current from flowing long enough to reach the first peak. Since the "Cordon" Circuit Breaker limits both the magnitude and duration of the short circuit current, magnetic and thermal stresses on circuit components are materially reduced.



100 amp "CF" Frame | 225 amp "CK" Frame | 400 amp "CKL" Frame | 600 amp "CL" Frame

A COMPLETE LINE OF "CORDON" CIRCUIT BREAKERS from 15 to 600 amp, 250 v d-c, 600 v a-c

I-T-E CIRCUIT BREAKER COMPANY

Small Air Circuit Breaker Division

ATOMS IN ACTION

START-UP of the research reactor at Armour Research Foundation opens a broad new approach to development of better petroleum products, predicts M. P. Venema, president of Universal Oil Products Co., one of the cooperating companies. He cited availability of radioactive isotopes with short half-life for experiments on mechanics of catalyst poisoning, chemical structure analysis through neutron diffraction, and investigation into possible radiation effects upon refining processes.

AN ANIMATED working model of the single-cycle 12,500 kw atomic power reactor that General Electric will furnish American and Foreign Power Co. for use in Latin America was displayed at the annual shareholders' meeting of Electric Bond and Share Co. and at a special gathering of shareholders of A & FP. The model bubbles water inside its core and steam drum and the path of the steam from reactor to turbine-generator is traced by illuminated plastic piping.

BYRON JACKSON PUMPS, INC. has made available to interested groups a demonstration nuclear liner type pump. The center pump housing is transparent Lucite so that circulation fluid may be watched as it moves from the pump through the heat exchanger and on through the flow indicator and expansion chamber before returning to the pump section. The model operates on 60 cycle, 110 or 220 v power.

CONTRACTS for design and drafting services on the conventional equipment section of the Indian Point, N. Y. nuclear power plant have been awarded to Vitro Engineering Div. by Consolidated Edison Co. Vitro will act also as architect-engineer for the reactor building and services under sub-contract to Babcock & Wilcox.

THE PHYSICAL CONSTANTS TEST Reactor in operation at Hanford, Wash. will be used to evaluate methods of constructing uranium fuel pieces and distributing them within present atomic reactors. Since the PCTR does not have to be disassembled after each test as did the sub-critical reactors previously used at Hanford, five times more tests are expected to be made per year. The reactor may also help suggest improved designs for new reactors built in this country.

TWO FILMS on atomic power have been made available by industry. "Atoms for Peace," produced by Allis-Chalmers, points out operating details of an experimental boiling water reactor, explains mechanics of fission and its control. The 16mm, color sound-film runs 18 min. Union Carbide & Carbon Corporation's film, "The Petrified River — The Story of Uranium," covers the geological history of the Colorado Plateau uranium deposits, mining industry on the Plateau, and use of uranium in reactors. The U. S. Dept. of the Interior, Bureau of Mines, Graphic Services Sections, 4800 Forbes St., Pittsburgh 13, will make arrangements for showings.

BROOKHAVEN National Laboratory has come up with a theoretical answer to the problem of disposal of radioactive wastes which entails concentrating waste into solid form and separation of elements with different radioactive half-life. Some of these isotopes then could be sold for industrial uses, medical research, and for food irradiation. Blaw-Knox Company's Chemical Plants Div. has been engaged to prepare plans for a workable plant and machinery incorporating these ideas.

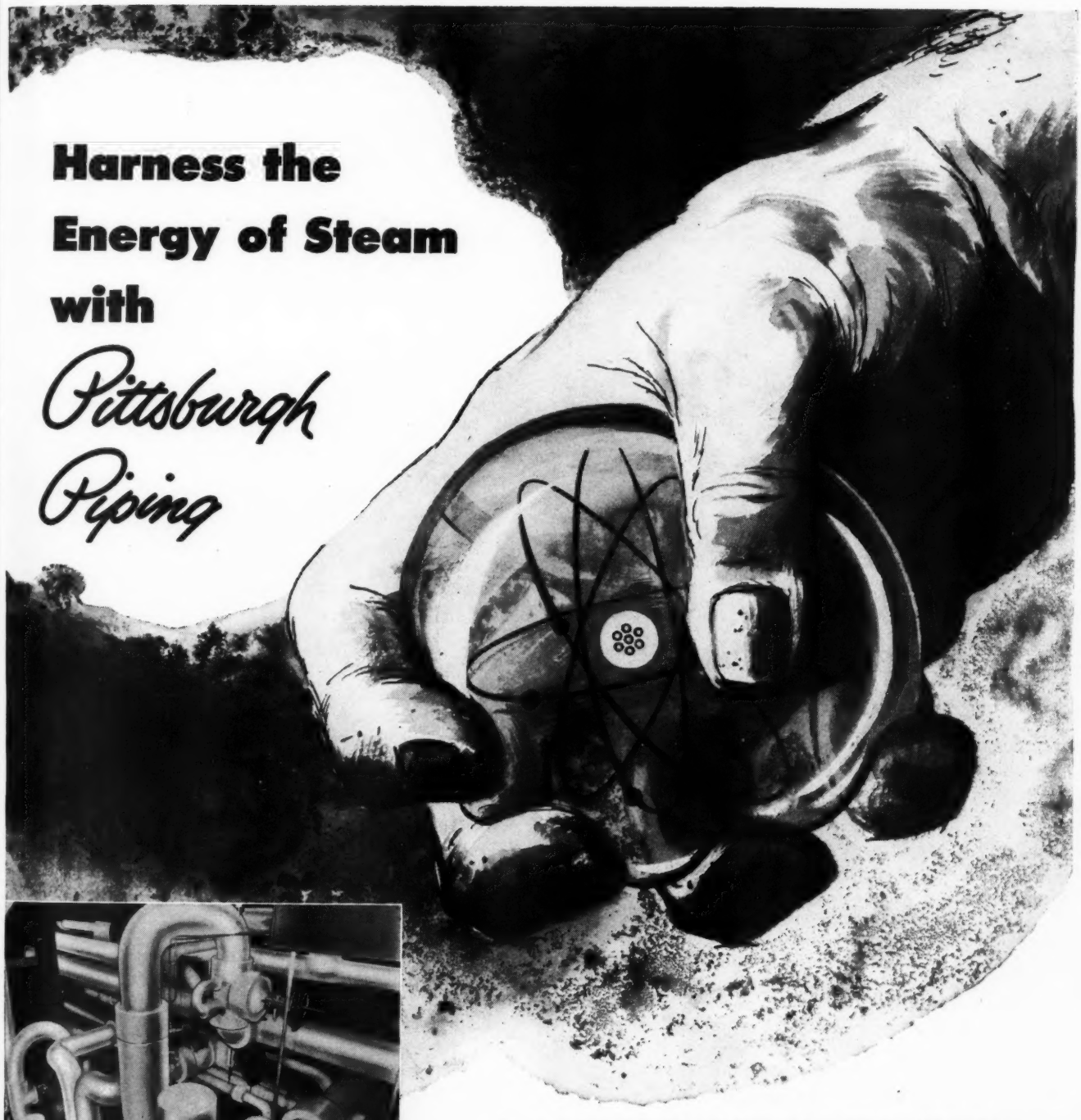
CONGRESS ADJOURNED with two important atomic energy bills still hanging fire. S. 4112, introduced by Clinton Anderson, which would have permitted the federal government to indemnify reactor builders and operators up to $500 million above their third party liability insurance from private sources, was not even called up for a vote. S. 4146, known as the Gore bill, would have directed AEC to spend $400 million on large and small demonstration power reactors at AEC sites and lend assistance to other countries over a five-year period. This bill was defeated in the House after having passed the Senate.

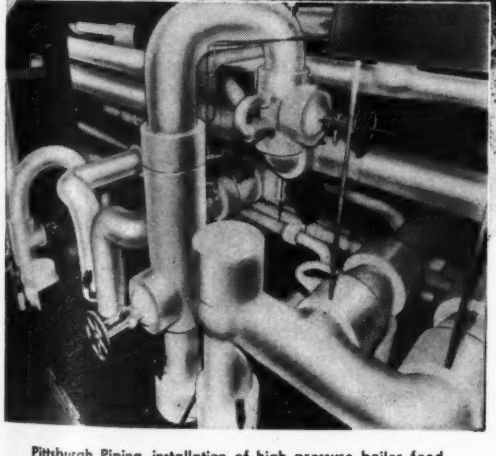
PASSED BEFORE ADJOURNMENT was the bill authorizing construction of a nuclear powered merchant ship. And under an omnibus bill passed in July, AEC will be able to make grants and contributions to the cost of construction and operation of reactors, facilities, and equipment to colleges, universities, hospitals, and charitable institutions for educational and training activities.

UNDER CONTRACT with the Army Chemical Corps, Armour Research Foundation is investigating the feasibility of using radiation for the sterilization of sewage containing bacteria, viruses, fungi, and toxins.

DR. WALTER H. ZINN, formerly head of AEC's Argonne National Laboratory, has organized a new firm under the name of General Nuclear Engineering Corp. to provide engineering and related services for design, construction, and operation of nuclear reactors and other atomic energy facilities. Harold V. Lichtenberger, John M. West, and Dr. Joseph R. Dietrich, all formerly with Argonne, are associated with Zinn in the venture. Headquarters will be in Dunedin, Fla.

Harness the Energy of Steam with *Pittsburgh Piping*





Pittsburgh Piping installation of high pressure boiler feed piping in central station.

Are you interested in piping to harness the flow of superheated steam, gas or liquid, or to control the corrosive action of process materials?

Call upon Pittsburgh Piping for this type of piping . . . for the electric generating station, nuclear power installation, chemical processing plant, refinery, mill, or factory.

We are specialists with complete facilities, and we assume responsibility for every phase of a piping job — from blueprint through erection.

Pittsburgh Piping

AND EQUIPMENT COMPANY

158 49th Street — Pittsburgh, Penna.

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835 BEACH ROAD—HAMILTON, ONTARIO

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Carbon Steel Piping	Forged Piping Materials
Cast Iron Fittings	Headers
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Copper Piping	Stainless Steel Piping
Corrugated Piping	Van Stoning
Creased Bends	Welded Assemblies
Expansion Bends	Welded Stainless Steel Tubing
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Toronto	68 Yonge Street

Economic News Notes

E. F. MacDonald
INDUSTRIAL ECONOMIST

INSUFFICIENT TOOLS—Once again Congress refused increases in appropriations requested in order to improve the work of gathering statistical data on construction activity. An increase of $720,000 had been requested for this purpose, but unlike most other requests concerning statistical programs, which were granted at least in part, the construction increase was rejected 100%. Congressman Bolling, Chairman, Subcommittee on Economic Statistics of the Joint Economic Committee, commented, "The construction industry is one of the most important continuing economic forces with which we must deal in any appraisal of the economic outlook. Failure to provide the requested improvements in construction statistics leaves . . . scattered data of growing inadequacy."

CHAIN REACTION — The new highway program will have a decided impact on retail trade, reports the National Highway Users Conference. It points out that construction of shopping centers, service stations, motels, and restaurants will be promoted by new highway patterns.

POSSIBLE SURFEIT—While the new highway program is likely to give rise to construction of new shopping centers in many new areas, at present Long Island is in danger of becoming oversupplied with retail stores. The latter point is made in a report by Hofstra College Bureau of Business Research showing that the rate of increase in the number of retail stores is outstripping that of population, income, and retail sales on the Island.

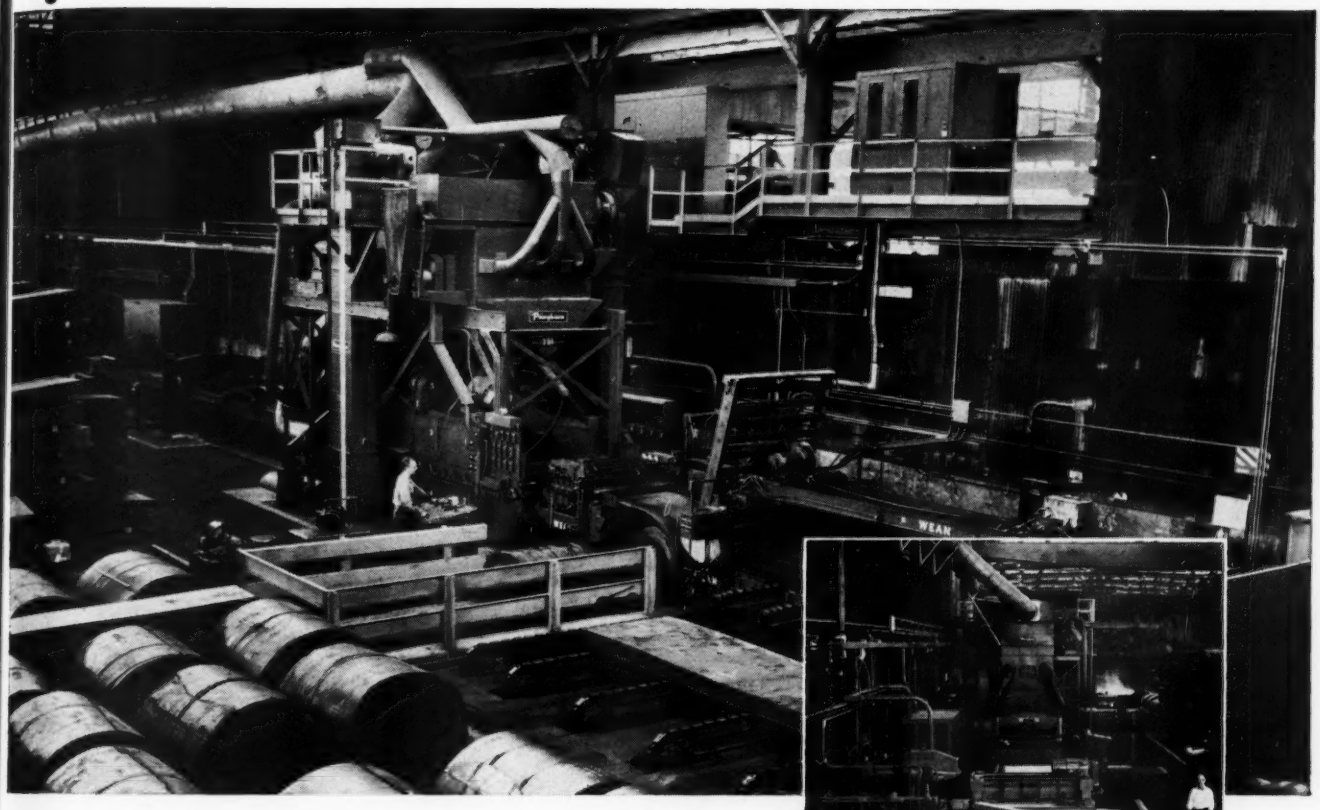
MUTUAL BENEFIT—The Advisory Committee on Science Manpower, appointed by the New York City Board of Education, is considering the possibility of recommending the employment of retired engineers and scientists to alleviate shortages of math and science teachers. "In order to determine if such a supply of prospective teachers exists," all interested engineers and scientists are urged to write to Mr. S. Schenberg, Board of Education, 110 Livingston St., Brooklyn 1, N.Y., enclosing a brief biographical sketch.

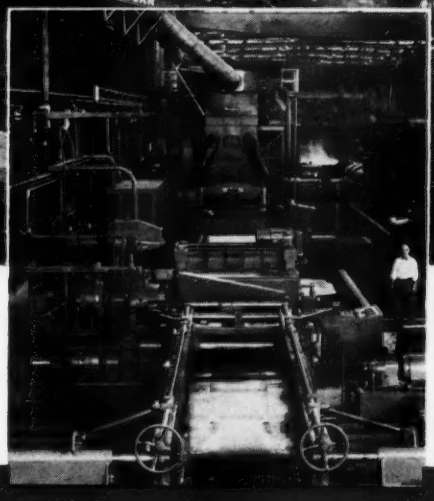
EGG-BEATER STATIONS — A pamphlet, "Heliport Location and Design," has been published by the Port of New York Authority. Particular difficulties arise from the fact that in commercial operations, helicopters use relatively flat approaches and take-offs and avoid hovering. It is pointed out that the study, made for the N.Y.-N.J. area, may be used for design and construction in other areas.

PROFESSIONAL STANDARDS — "The fact that there has been a trend toward collective bargaining by engineers, in spite of widespread reluctance to participate in such action, indicates the existence of unsatisfactory conditions." On this reasoning, a recent report by the Engineers Joint Council goes on to make seven recommendations toward providing and maintaining "an employment environment which encourages full professional and technical development . . ." See "Professional Standards and Employment Conditions"

PORT CONSTRUCTION—Study is under way in South Carolina for a $10-million dock construction project to provide cargo berths and warehousing facilities at three state ports. The S.C. Port Authority visualizes this as the initial step in a ports development program that will entail further outlays of $20-30 million. Economic development in the South is reflected also in a three-year, $20 million port-construction program at New Orleans. A longer-range project there will convert all timber wharves to steel and concrete at a cost of around $70 million.

THROUGH THE TRANSIT—Louisiana is the 18th state to require contractors to be licensed to do business in the state. . . . Mark-of-the-times: Announced investment in new plant and expansions in the Baltimore area during the first half of this year amounted to 99% of the total for the 12 months of 1955. . . . Failures of construction firms in the first half reached record levels, reports Dun & Bradstreet. . . . The new GE plant to be built in Murfreesboro, Tenn., is the 22nd one that the company has or plans to locate in the South. . . . Approval is being sought by General Services Administration for construction or purchases of 35 Federal buildings costing around $229 million in 21 states and Hawaii under the lease-purchase program. . . . Idea Dept.—The Adolphus Hotel in Dallas has a drive-in lobby. . . . Shortages of structural steel are going to be such a block to construction in the months ahead that they are likely to result in long-run improvements in the basic situation. . . . Expansion plans continue to roll—Armco will add 9% to its ingot capacity at Middletown.





CUTS AND CLEANS UP TO 50 TONS AN HOUR— *Automatically*

It's one of the world's first automotive steel cut-up lines, owned by Parish Pressed Steel Div.—Dana Corp., Reading, Pa. This line cleans, cuts-to-length, lubricates, levels, and coils or stacks up to 50 tons of hot rolled steel an hour.

The line is made up of several separate machines —an uncoiler, a shear, a shot-blast cleaning machine, an unpiler, a lubricator, and a coil winder or stacker —all joined by a conveyor system containing pinch rolls and leveling rolls. Yet the whole line operates as one giant machine, thanks to perfect coordination provided by Reliance V★S Drives.

V★S Drives furnish an unusual flexibility to the Parish line too. Sheet speeds can be varied from 40 feet per minute up to 160 fpm. to accommodate various thicknesses and widths. From the master control, and the three supporting control stations, any one operation or combinations of operations can be eliminated from the line. Thus the line is not limited to just one set series of functions.

This application of Reliance Motors and Drives —to control tension, to synchronize operations, to regulate speed—is typical of the jobs done by the Reliance Applied Engineering Department.

L-1511

If you would like further information on the application of V★S Drives in your plant write:

RELIANCE V★S DRIVE®

RELIANCE ELECTRIC AND ENGINEERING CO.

DEPT. 339A, CLEVELAND 10, OHIO • CANADIAN DIVISION: WELLAND, ONTARIO

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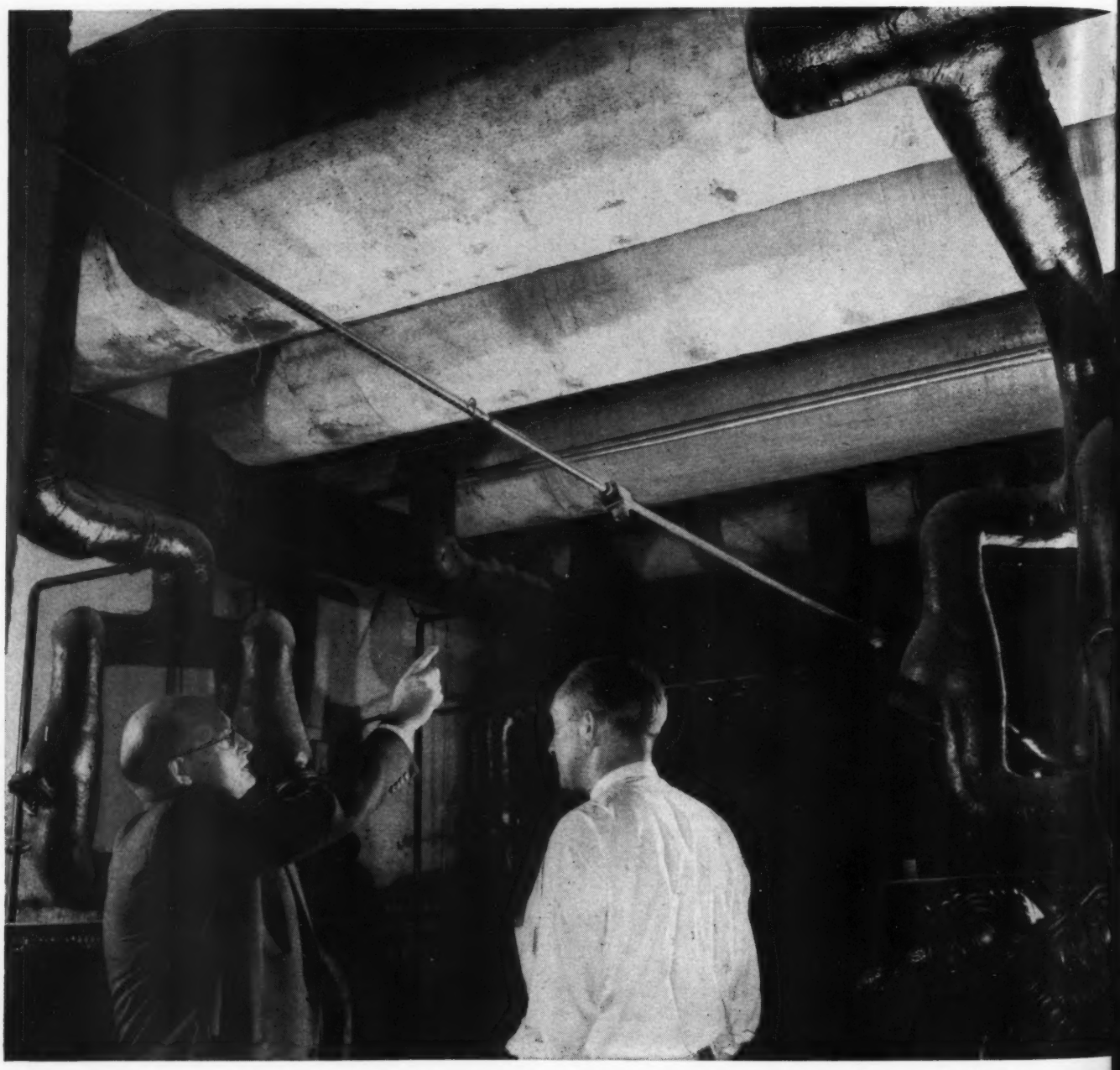
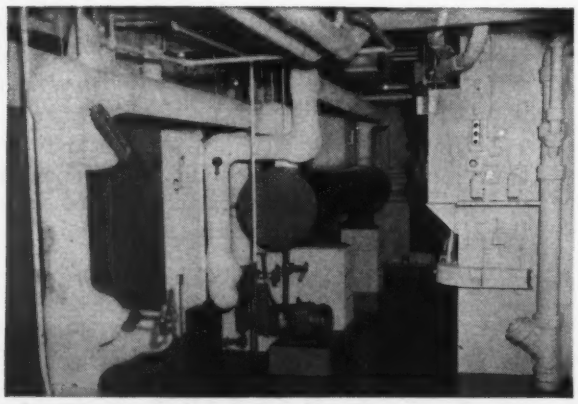
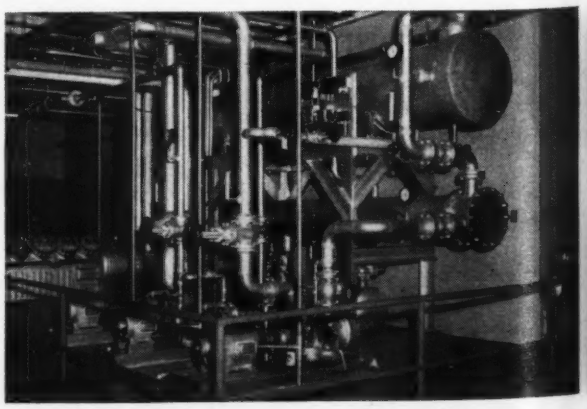


"They've never given us a bit of trouble," states Mr. R. E. Noll (left), Store Superintendent. With him is Mr. J. L. Quisenberry, Head of Maintenance for Wolf & Dessauer, who has been with the store since the eight Dry-Ex units were installed in 1937. The system, including eight 50 hp condensing units and 15 remote air handling units, air conditions the main building's seven floors. The system was installed by Hipskind Heating and Plumbing Company of Ft. Wayne.



MODERN DRY-EX CHILLERS do all kinds of air conditioning, refrigeration and industrial, direct-cooling jobs. This Dry-Ex air conditions the Anderson Loan Association building at Anderson, Indiana. The 50-ton system also utilizes an Acme evaporative condenser.



100-TON DRY-EX AND ACME FREON CONDENSER are major components of this Cincinnati, Ohio air conditioning installation in Western & Southern Life Insurance Company's modern office building. Two Acme Flow-Mizer® cooling towers allow constant re-use of condenser water.

19 YEARS OF TROUBLE-FREE SERVICE

First Acme Dry-Ex® Chillers still in operation in famous Indiana department store

Operating with full capacity and efficiency since 1937, eight Acme Dry-Ex Chillers in the Wolf & Dessauer department store, Ft. Wayne, Indiana have never required any maintenance other than routine cleaning. As a result, in almost 20 years of operation, this busy store has never lost a day's air conditioning through interruption of service by these Acme units.

In originating the Dry-Ex Chiller, Acme created a component for air conditioning and refrigeration systems that have withstood the tests of time and tough requirements in thousands of diverse applications. The fact that 80% of the direct expansion chillers in use today are of Acme manufacture is proof of industry-wide preference for the Dry-Ex.

Now More Efficient Than Ever

The modern Dry-Ex combines the dependability of Acme's thru-tube construction, proven in 19 years of broad field experience, with the added efficiency of an exclusive star-insert tubing. You receive more chilling capacity per dollar of investment than ever before.

Acme custom builds Dry-Ex Chillers, utilizing standardized parts, to meet exactly the conditions of virtually any water chilling or other liquid cooling application. Capacities from 5 to 400 tons are available in single or multi-circuit units. Two model series, one with star-insert tubing and the other with plain tubing, are available. A wide range of baffle and head pass combinations make it possible to achieve ideal, controlled liquid velocities.

To Get Your Copy of Acme's data-packed Dry-Ex catalog, just send us this coupon attached to your letterhead

Acme INDUSTRIES INC. Jackson, Michigan

Dry-Ex Liquid Chillers | Liquid Receivers | Heat Exchangers | Condensers | Packaged Chillers | Packaged Heat Pumps | Evaporative Condensers & Cooling Towers | Room Conditioners

Manufacturers of Quality Air Conditioning and Refrigeration Equipment since 1919

ME'S PROVEN THRU-TUBE CONSTRUCTION has tubes ex- ng straight through to multi-pass heads at each end. No tubing s — less pressure drop! No soldered joints — no leaks! With ht, unobstructed passages, high refrigerant velocity and positive turn are achieved.

ACME'S EXCLUSIVE STAR-INSERT TUBING, a major advancement in chiller design, has more than twice the heat transfer of plain tubing. It means more chilling capacity per dollar in a smaller, lighter unit that is easier to install. Freight and handling costs are less, too.

The Legal Aspect

MELVIN NORD, P.E.
Consultant in Legal and Technical Problems
Patent Attorney

Engineering Registration Laws (II)

THE FIRST PROBLEM in connection with eligibility for engineering registration in a given state pertains to residence and citizenship.

Residence Requirements

In most statutes, there is no requirement that a person seeking registration by examination in a given state must be a resident or citizen of that state. Provision also generally is made for registration of non-residents without examination if they are registered in their own state and their state affords reciprocal privileges to the state where registration is now sought; provided the requirements for registration are no lower in the state of actual residence than in the state where registration is now sought. Thus, in most instances, a resident of one state can become registered in another state, either by examination or by reciprocity. However, there are some important exceptions to this rule.

Two jurisdictions (Alaska and Georgia) require an applicant for examination to be a resident. In these jurisdictions, a non-resident cannot be registered except by reciprocity.

Citizenship Requirements

Eleven jurisdictions (District of Columbia, Minnesota, Missouri, Nevada, New Jersey, New York, North Carolina, Pennsylvania, South Dakota, Virginia, and Wyoming) have no residence requirement for examination, but require that the applicant be a citizen of the United States (or in certain cases, have taken out his "first papers"). One state (Michigan) requires the applicant to be a "citizen of Michigan." If this means what it says, it goes further than any other statute, since in order to be a citizen of a state, a person must be a citizen of the United States and domiciled in the state.

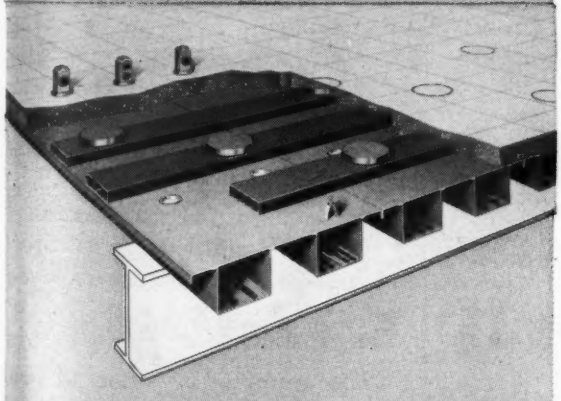
The term "domiciled" is stronger than "resident of," since it means that the person intends this place to be his home indefinitely. A person may intend to be a temporary resident of a place, but he cannot be temporarily domiciled in a place. Furthermore, a person may be a resident of more than one place, but he cannot have more than one place of domicile. In the construction of statutes in general (not specifically the engineering registration statutes), the term "resident" has frequently been construed to have been mistakenly used and has been interpreted to mean domiciled. Similarly, the requirement that a person be a citizen of a state has sometimes been construed to mean merely that he be domiciled within the state. Thus, there is possibility of ambiguity in the residence and citizenship requirements of Alaska, Georgia, and Michigan.

Effect of Foreign Treaties

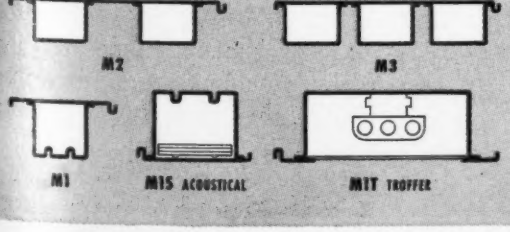
In the fourteen jurisdictions that require U.S. citizenship or residence within the state, there is another possible difficulty. A number of foreign countries have treaties with us providing for "most-favored-nation" treatment. These treaties state that if the United States grants certain rights by treaty to country X, then these other countries having "most-favored-nation" clauses in their treaties with the United States automatically have the same rights. Now, it so happens that there are certain treaties that grant citizens of foreign countries the privilege of practicing their profession in the United States. These treaties are the "law of the land" and are thus paramount to state statutes. As a result, it should not be assumed that an alien cannot be registered by examination in one of the eleven states

M-FLOORS . . .

Cost Less . . . Provide Electrical Availability Everywhere!



Cross Section of an Electrified M-Floor constructed with Mahon M-Floor Section M2. M-Floor Cel-Beam Sections are available with either Two or Three 6" wide Cel-Beams in a 24" width. Also available are Cel-Beam and Open-Beam Sections for long span roof construction; Perforated Acoustical Sections for combined roof-ceiling construction; and Acoustical and Troffer Sections for recessed lighting in concrete joist and slab construction of floors and roofs.



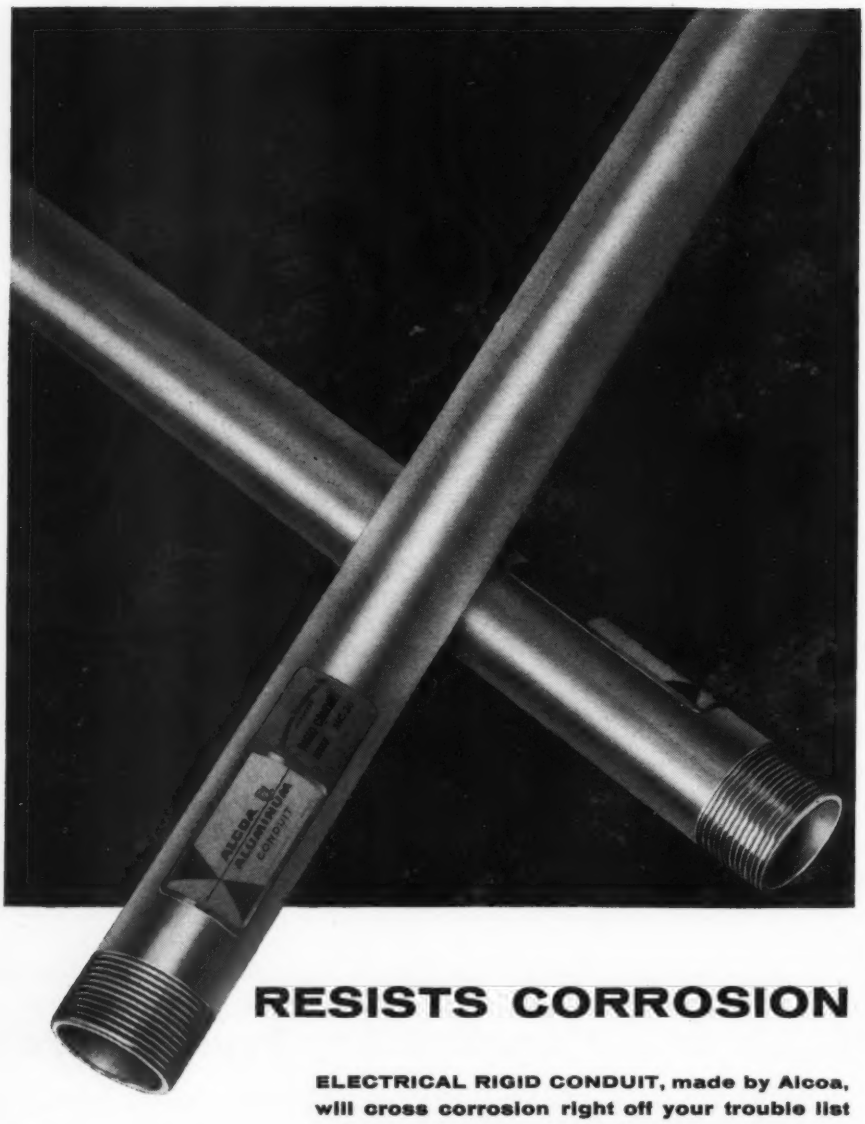
In addition to the structural function of M-Floor Sections, Cel-Beams in electrified installations provide the unlimited built-in raceway capacity which insures a building against electrical obsolescence in years to come. When you have decided on Cellular Steel Floor construction, call in a Mahon engineer and have him show you the many advantages which have been engineered into the design of M-Floor Cel-Beam Sections. You get higher Section Modulus with less weight in M-Floors . . . the Strength/Weight ratio of M-Floor construction will save up to 30% in the structural frame and foundation of some multiple story buildings. Cel-Beams in M-Floors are wide enough to permit 4" diameter access handholes between Electrical Header Ducts and Cel-Beam Raceways, yet they are narrow enough to provide adequate and evenly distributed beam-web support for the top plate. These are important design features . . . features which have direct and far-reaching effects not only on the initial building cost, but in the cost of subsequent changes in electrical and communication circuits throughout the life of the building. You'll want to compare these important design features before you select a Cellular Steel Sub-Floor for your next building. See Sweet's Files for complete information, or write for Catalog M-57.

THE R. C. MAHON COMPANY • Detroit 34, Michigan

Sales-Engineering Offices in Detroit, New York and Chicago • Representatives in Principal Cities

Manufacturers of M-Floors (Electrified Cel-Beam Floor Systems), Insulated Metal Walls and Wall Panels, Permanent Concrete Floor Forms, Steel Roof Deck and Long Span M-Decks, Rolling Steel Doors, Grilles and Underwriters' Labeled Automatic Rolling Steel Fire Doors and Fire Shutters.

MAHON



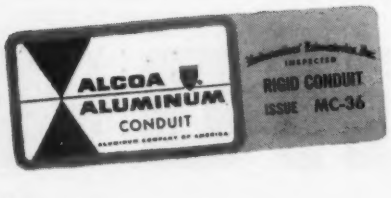
RESISTS CORROSION

ELECTRICAL RIGID CONDUIT, made by Alcoa, will cross corrosion right off your trouble list ...for aluminum won't rust and resists corrosion even in contaminated areas. Excellent for exterior use. And it rarely needs painting.

Because aluminum is so resistant, so durable, so ideal for electrical rigid conduit, it is the best investment you can possibly make. It outlasts other conduit many times over . . . saves continuously on maintenance.

Moreover, it is nonsparking, nonmagnetic. It has the approval of Underwriters' Laboratories. Its nonmagnetic feature means less voltage drop, points the way to installation savings . . . for you can run longer lines or use smaller wires. And you can separate conductors regardless of load.

Get the complete details on good-looking, long-lasting Alcoa® Aluminum Electrical Rigid Conduit from your local Alcoa sales office. Or write Aluminum Company of America, 2330-J Alcoa Building, Pittsburgh 19, Pennsylvania.



Your Guide to the Best in Aluminum Value

THE ALCOA HOUR
TELEVISION'S FINEST LIVE DRAMA
ALTERNATE SUNDAY EVENINGS

mentioned. Whether or not he can depends on the treaty relationships between his country and the United States.

Other Qualifications

In addition to residence and citizenship qualifications, which we have found to be present in fourteen jurisdictions, other qualifications frequently required are good moral character and certain experience and educational prerequisites.

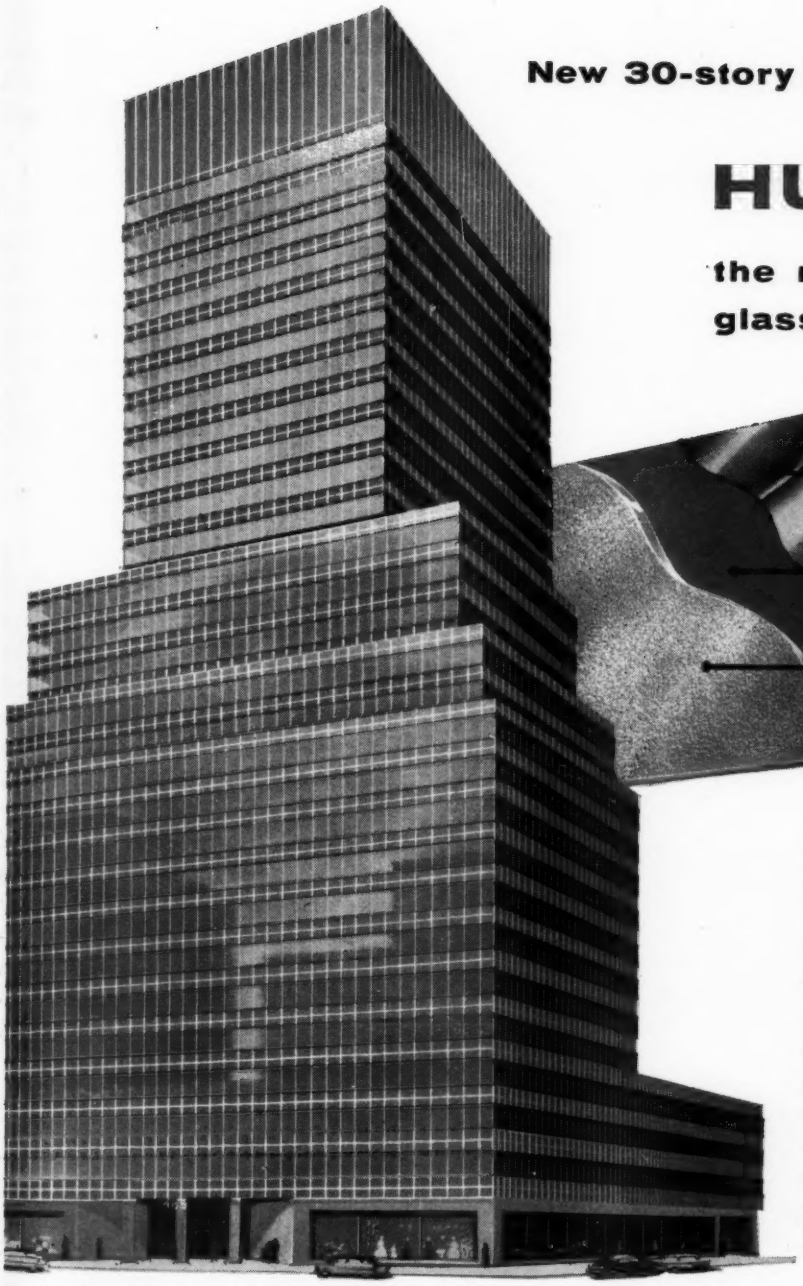
Examination

In many states, registration other than by reciprocity does not always require an examination. For example, in Alabama graduation from an approved course in engineering plus four years of experience is sufficient qualification without examination; but a non-graduate must pass a written examination and have eight years of experience. Essentially the same is also true, with some modifications, in Illinois, Iowa, Kansas, Kentucky, Maine, Massachusetts, Nebraska, New Mexico, North Dakota, Oklahoma, Rhode Island, Texas, Utah, Vermont, Wisconsin, and Wyoming. In a number of states, the board has the option to waive examination in certain instances. In a number of states, an appicant over 35 years old and having 12 years of experience can be registered without examination.

When examination is required, it may be oral, written, or both.

Years of Experience

The number of years of experience required of a non-graduate varies from 6 to 12 in the various jurisdictions. The most frequent requirement is 8 years. In practically every jurisdiction, graduation from an accredited engineering school can replace four years of the experience requirement, and one year of graduate credit also can replace a fifth year of experience. Thus, experience is always required, but formal education is never an ab-



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welded to the back, protects the enamel, reflects heat, insulates.

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fused to the back of the glass, adds permanent beauty in the color desired.

TEMPERED GLASS
5/16" thick is textured on the weathering side to subdue bright reflections.

Huetex is an ideal low-maintenance, high-quality spandrel material. Its lasting beauty is assured by the permanence of ceramic enamel color protected from the elements by glass. And, the glass is tempered . . . tempered to the mechanical strength of 3 to 5 times that of ordinary glass of the same thickness; 6 to 8 times the impact strength. *Huetex* can be used with a variety of framing systems and insulation of your choice. For descriptive brochure write to Dept. H-796, Libbey·Owens·Ford Glass Co., 608 Madison Ave., Toledo 3, Ohio.

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solute requirement. For this reason, the definition of a professional engineer as "a person who by reason of his knowledge of mathematics, the physical sciences, and the principles of engineering, acquired by professional education and practical experience, is qualified to engage in engineering practice" is a faulty definition. Although examinations frequently are supposed to show education equivalent to graduation from an engineering college, it hardly can be said that they establish actual "professional education."

Reciprocity

Most states permit automatic registration of non-residents who are registered in their own state or country, provided the standards of their state or country are no lower than those of the state in which registration is now sought. In some, but not all of these states, this privilege is granted only if there is reciprocity between the jurisdictions in question, i.e. if the other jurisdiction affords the same privilege to residents of the jurisdiction in which registration is now sought.

Temporary Permits

Practically all jurisdictions provide for temporary and special permits to practice engineering without registration. Non-residents and recent arrivals in the jurisdiction are generally permitted to practice 30 to 60 days in any one year without registration or application for registration. If they wish to practice for a longer period, they must apply for registration and they can practice during such time as may be required for consideration of their application.

Discrimination Question

It has been suggested by an eminent authority on the subject (Alfred L. McCawly, in *Professional Engineering Registration Laws,* p 536) that granting permission to non-residents or recent arrivals to practice temporarily

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...has uses in:

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Many operations can be improved by using *Synduction* motors. Allis-Chalmers invites your inquiry. Call your nearby A-C office or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin, for Bulletin 51B8440.

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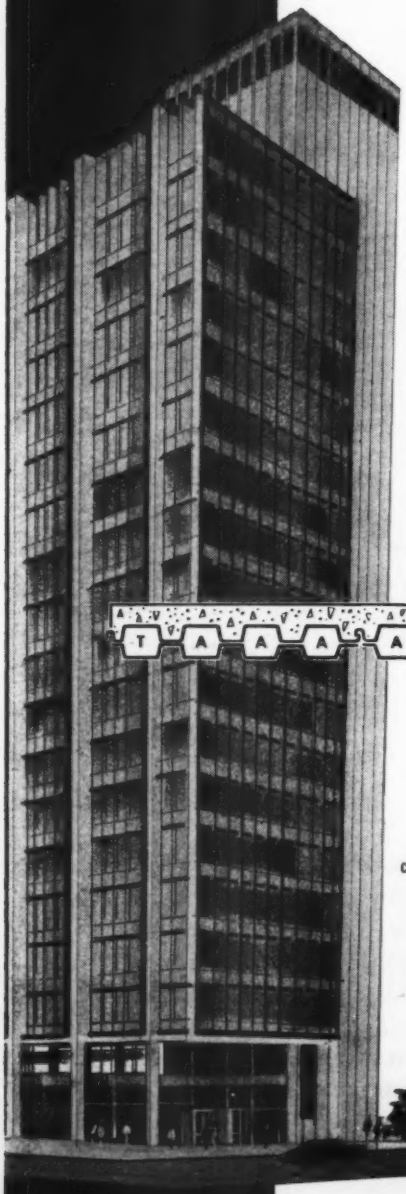

An extraordinary architectural achievement is taking form on the skyline of Chicago's Loop — it's the distinguished new headquarters building of the Inland Steel Company. Here is the ultimate in imaginative planning and engineering — unprecedented today, sure to be abreast of the best tomorrow.

The Inland Steel building has 19 floors — without interior columns. It has the longest clear spans of any tall building ever built. Its utilities are in a separate tower. Absolutely nothing obstructs the floor space.

Air-transfer for year-around air conditioning plus power and communications pathways for all the potentials of the electronic age are provided *in the floor* — in Milcor Celluflor, the cellular steel floor that combines light weight with great strength.

Celluflor is made of TI-CO®, the galvanized steel with the protective coating that won't flake or chip. Celluflor was selected for warm and cool air distribution because TI-CO galvanizing protects against time, temperature and humidity.

For more information on the interesting Inland Steel Building design, or for Catalog 270 which describes Milcor Celluflor construction, write to address listed below.

Cross section of the Milcor Celluflor installation in the Inland Steel Building, showing the cells and the 2-inch concrete fill which covers them. The letters in the cells show the pattern of use developed for this installation. (Key: A-Air; P-Power; T-Telephone.)

Milcor Celluflor provides variable capacities to handle any type of electrical need. Cells are spaced on 6-inch centers to permit the installation of service outlets at virtually any point on the floor.

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M-181E

during pendancy of their application, without granting a corresponding privilege to residents, is unconstitutional since it is discriminatory against residents and hence violates the "equal protection of the laws" clause of the United States Constitution. However, there apparently is no case that has held this to be so. The test of discrimination under the "equal protection of the laws" clause is whether there is any reasonable ground for the distinction between groups. If the distinction is arbitrary, it is definitely unconstitutional; but if it is based on a legitimate reason, the provision is valid. In the opinion of the writer, the distinction between residents and non-residents, insofar as temporary permits is concerned, is entirely reasonable and hence valid. A resident cannot complain that he had no reason to apply for a permit until the last minute. But a non-resident has complete justification for not applying for registration in every state and territory. When he finds need to be registered in a state other than his own, it is proper for him to consult the state board. He cannot be expected to apply for registration beforehand. ▲▲

ARTICLE REPRINTS

For free copies of reprints listed below, write on company letterhead to Reader Service Dept.,

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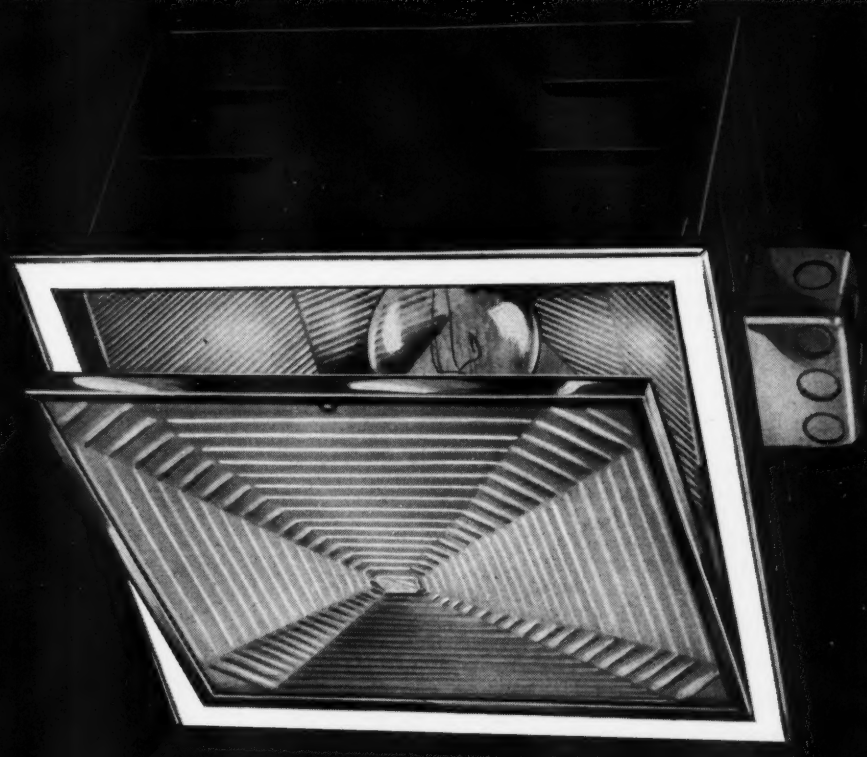

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If you are looking to a future increase in your business and your profits—be sure you get KIRLIN Fixtures when you ask for them. Their many advantages for your customers, and the greater light output, help to build good will for your business. Their many direct advantages to you, such as easier and quicker installation, make more money for you.

However, KIRLINs are being imitated in appearance just like the leading products in other fields are imitated. The distinctive color combination on recessed fixtures, the white frame and bright metallic door, was originated and *copyrighted* by KIRLIN; how many other makes can you name who have tried to make their fixtures "look like KIRLINs?"

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When you are faced with the problem of protecting piping underground in highly corrosive soils, a high quality coal tar coating such as called for in AWWA Specifications C-203 and C-204 is normally hot applied at a pipe coating mill. However, in many cases, the volume of pipe does not warrant this expense or the coating mill is too far away to justify the time involved.

That's WHEN Engineers Specify TAPECOAT®

. . . the practical alternate hot-applied coal tar coating in handy tape form

Because TAPECOAT provides a coal tar coating equivalent in long-life protection to hot-applied coating at the mill, engineers are specifying this quality alternate material where time and cost factors preclude mill application.

This practical solution assures the protection required without the need for tar kettles, technical know-how and special crews. Field application costs are reduced because TAPECOAT is so easy to apply, using a torch to soften or bleed the pitch and then spirally wrapping it on the vulnerable surface.

TAPECOAT comes in handy rolls of 2″, 3″, 4″, 6″, 18″ and 24″ widths. Since 1941, it has proved its ability to give lasting protection to pipe, pipe joints, couplings, conduit, cable and insulated piping.

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Report From South Africa

PETER HOLZ

CONSULTING ENGINEER Correspondent

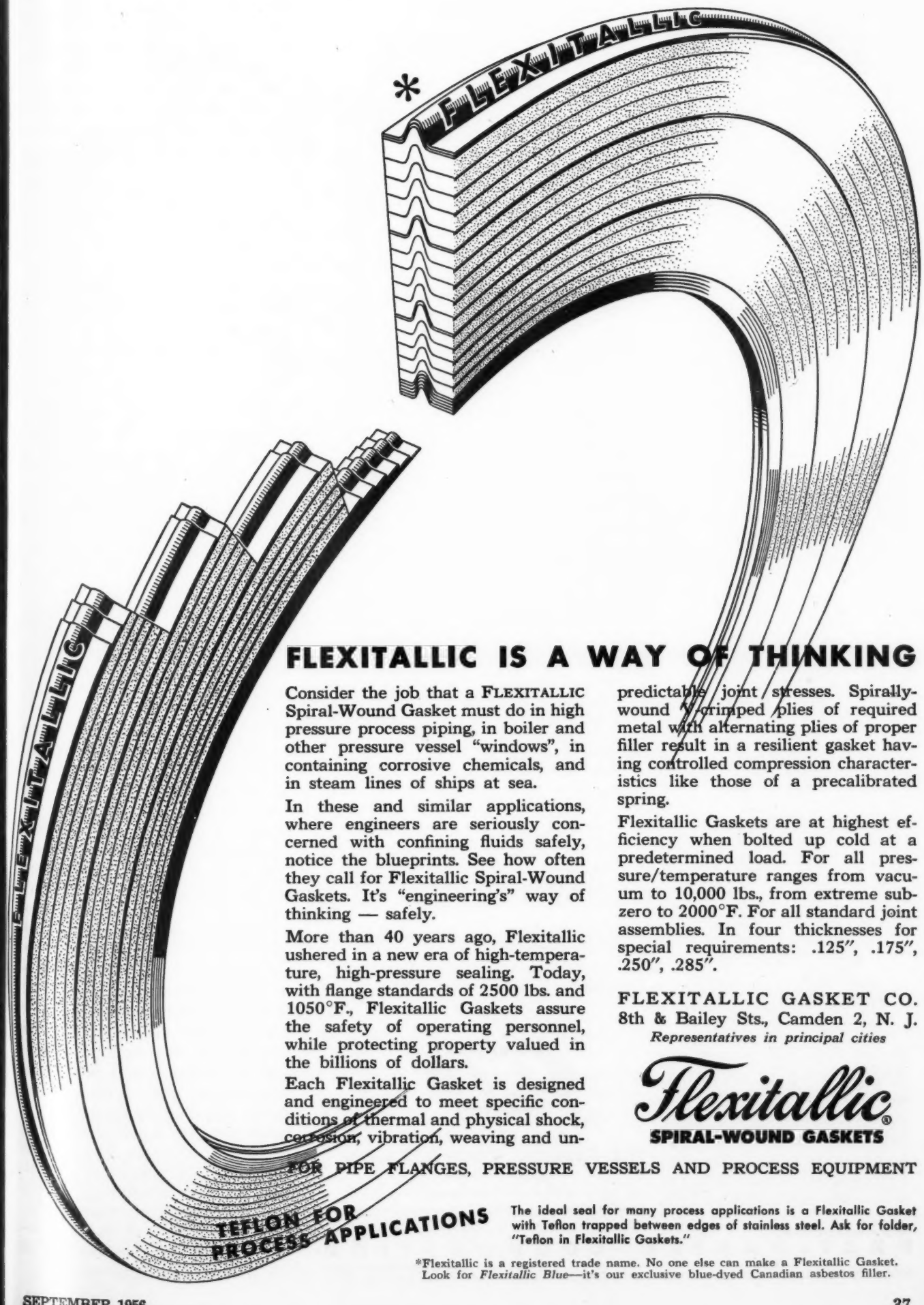
NO COUNTRY in Africa is more technically advanced than the Union of South Africa. Despite its small European population, tremendous strides have been made in industry, and major construction project follows major construction project. As in America, there is a shortage of engineers, and where consulting engineers are concerned this shortage is most noticeable. In the whole of South Africa only 37 engineers in private practice belong to a recognized body—the South African Association of Consulting Engineers. Of this small number, four are structural consultants, eight are electrical and mechanical, while the balance are civil engineers. It is true that there are consultants who are not members of this body, but most of these, I was led to believe, are not sufficiently qualified to belong.

To become a member of the South African Association of Consulting Engineers, an engineer must be in continuous practice as a consultant — either individually or as a partner in a firm of consulting engineers. He must have standing and experience that will convince the Association's membership committee that he is qualified to practice as a consulting engineer. Every member of the Association belongs to at least one, and quite often to several, of South Africa's engineering institutes.

There is only one grade of membership, and those elected may under no circumstances be directors, managing directors, or employees of any company carrying on any contracting or manufacturing business dealing with the type of work to which his practice relates. Furthermore, no member may be a partner in such a business nor is any member permitted to advertise or canvass for consulting work. The secretary of the Association even forbade me to mention the names or addresses of any of the members.

The Association has a strict code of ethics. I have taken these from a booklet of theirs entitled "The South African Association of Consulting Engineers — Professional Rules and Practice":

¶ Every member shall act in all professional matters in a strictly fiduciary capacity with regard to



FLEXITALLIC IS A WAY OF THINKING

Consider the job that a FLEXITALLIC Spiral-Wound Gasket must do in high pressure process piping, in boiler and other pressure vessel "windows", in containing corrosive chemicals, and in steam lines of ships at sea.

In these and similar applications, where engineers are seriously concerned with confining fluids safely, notice the blueprints. See how often they call for Flexitallic Spiral-Wound Gaskets. It's "engineering's" way of thinking — safely.

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Flexitallic Gaskets are at highest efficiency when bolted up cold at a predetermined load. For all pressure/temperature ranges from vacuum to 10,000 lbs., from extreme subzero to 2000°F. For all standard joint assemblies. In four thicknesses for special requirements: .125", .175", .250", .285".

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FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

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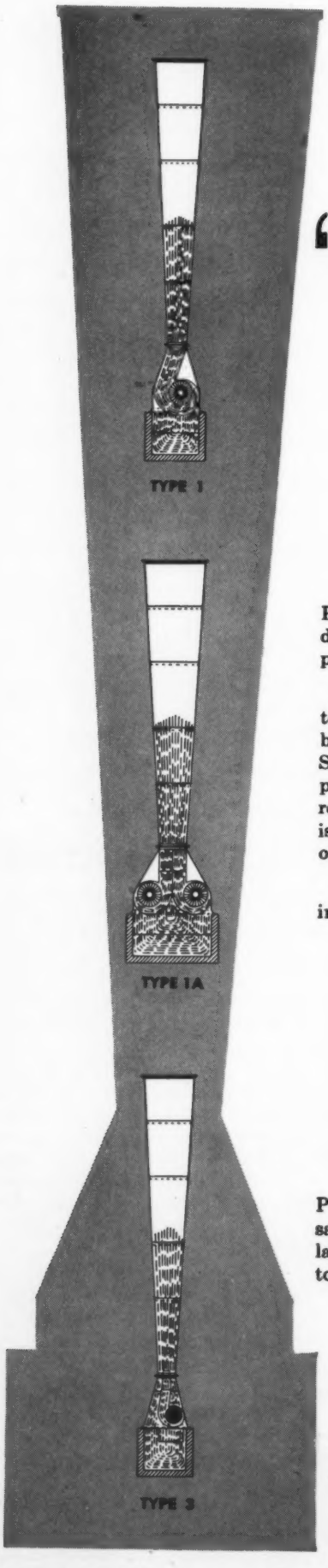
*Flexitallic is a registered trade name. No one else can make a Flexitallic Gasket. Look for *Flexitallic Blue*—it's our exclusive blue-dyed Canadian asbestos filler.



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any client for whom he may act, and his charges to such client shall constitute his only remuneration in connecion with such work.

¶ No member shall accept any trade commission, discount, allowance, or indirect profit in connection with any professional work on which he is engaged.

¶ No member shall without disclosing the fact in writing to his client be a shareholder in, or have a financial interest in any company carrying on any contract or manufacturing business dealing with the class of work to which his practice relates.

¶ No member shall receive directly or indirectly any royalty, gratuity, or commission on any patented or protected article or process used on or for the purpose of the work in respect of which he is acting for a client unless and until such royalty, gratuity, or commission has been authorized in writing by that client.

¶ Every member shall place orders explicitly on behalf of his client and not on his own behalf.

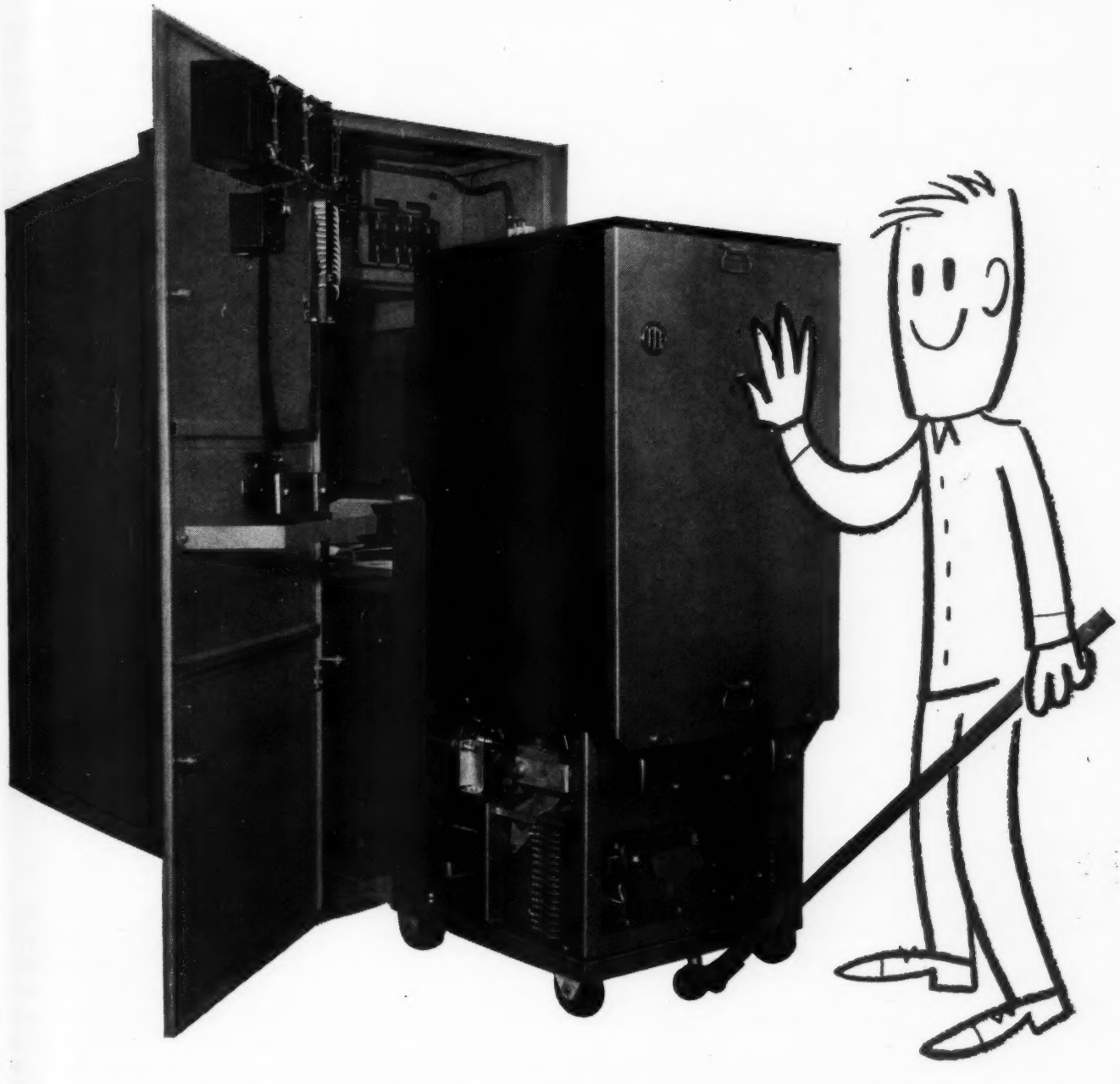
¶ Except at the request of his client, no member shall be the medium of payment to any contractor or business firm otherwise than by the issue of certificates for payment by his client.

¶ No member shall knowingly compete on the basis of professional charges with another member for employment.

¶ No member shall attempt, directly or indirectly, to supplant another member, nor shall he review or take over work of another member acting as a Consulting Engineer for the same client, until he has either obtained consent of such member or has been formally notified by the client that the connection of such member with the work has been terminated.

¶ No member shall take part in a competition involving the submission of proposals and designs for engineering work unless an assessor who shall be an engineer of acknowledged standing has been appointed, to whom all such proposals and designs are to be submitted for adjudication.

¶ No member shall advertise directly for professional employment nor shall he answer any ad for a consulting engineer.



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¶ No member shall solicit professional work either directly or by an agent, nor shall he pay by commission or otherwise any person who may introduce clients to him.
¶ No member shall practice in the name of a Limited Company or otherwise under the protection of Limited Liability.
¶ No member shall conduct himself in a manner, nor act in any capacity, nor hold any appointment, which in the opinion of the Committee, prejudices his position as a Consulting Engineer or as a member of the Association, or is prejudicial to its interests.
¶ The only abbreviation a member may use behind his name to signify his membership in the Association are the letters M. (S.A.) Cons. E.

Because of the varied nature of engineering work, it is not possible, nor for that matter desirable, to lay down fixed rates for professional fees. The following methods of computing charges are commonly employed by South African consultants:
¶ Percentage of cost fee—based on percentage of actual or estimated cost of work contemplated or constructed.
¶ Lump sum fee.
¶ Per day or per hour rate.
¶ Retainer fee.
Modifications of any of these bases, or some other unstated basis, may be used as especially applicable to a particular project. Percentage is the usual method of arranging fees for engineering services in connection with the construction of works, the installation of plants, or in connection with services in buildings. Under average conditions, for works of a general engineering character 10 percent may be charged by the consultant for the first $7,500 of cost. On the next $22,500 of cost, 8½ percent may be charged, the percentage rate ultimately dropping to 4½ percent.

Where the work is of an unusually complex nature, or where the work comprises substantial alterations or additions to existing structures, the fees may be modified by mutual agreement between engineering consultant and client. Fees for the design and supervision of works of electrical engineering or mechanical engineering

An engineering fact...

WROUGHT IRON PIPE takes up to a 50% heavier coating of ZINC

Tests prove the iron silicate fibers which give wrought iron its unusually high resistance to corrosion are also responsible for the material's ability to accept a considerably thicker hot-dip zinc protective coating than steel.

Our bulletin, *Piping for Permanence*, discusses galvanic protection, and reviews a variety of wrought iron pipe services. Write for your copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Division Offices in Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. International Division: New York, N. Y.

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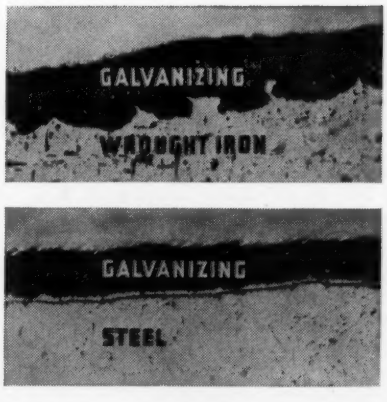

These photomicrographs illustrate the ability of wrought iron to receive a tighter, heavier zinc coating. Because the life of the coating is directly influenced by its adherence and weight or thickness, zinc coating on wrought iron lasts longer.

BYERS *Wrought Iron Tubular and Hot Rolled Products*

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At the Heart of most U.S.
HIGH TEMPERATURE WATER Systems

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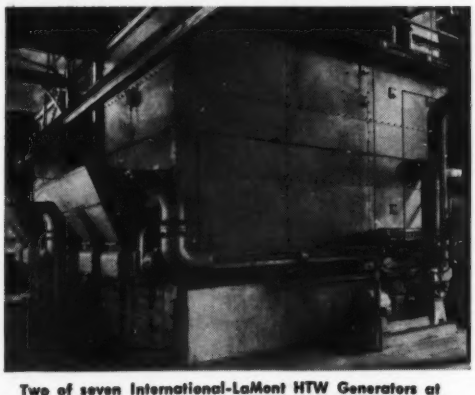
FORCED RECIRCULATION GENERATORS

Here is PROVEN SUPERIORITY based on Operating Performance & Exclusive Features



Two of seven International-LaMont HTW Generators at Lockbourne Air Force Base . capacity 218,000,000 Btu/hr.

- THERMAL SHOCK ELIMINATED by exclusive BUILT IN ECONOMIZER. System return water is circulated through economizer section and brought close to saturated temperature by flue gases BEFORE reaching radiant furnace zone.
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- LOW HEADROOM BOILER. Minimum height reduces cost of boiler house construction . . . permits installation in many existing structures.
- MAXIMUM HEAT ABSORPTION with minimum stack losses due to highly efficient MULTI-PASS design.
- LOWER INSTALLATION & MAINTENANCE COSTS. Exclusive unit construction reduces erection costs over 50%. Complete tubular boiler sections fabricated, tested and inspected before shipment.
- OPERATING INSTALLATIONS SINCE 1952 . . . Pressurized furnace or induced draft operation . . . Individual boiler circulating pumps or combined pump system if preferred.
- COMPLETE RANGE OF SIZES. From 6 to 200 million Btu per hour or larger . . . design pressures to 500 psi with corresponding temperatures . . . for firing with any type of fuel.

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nature follow more or less the same pattern. Generally, 10.26 percent may be charged for the first $2500. By the time the work costs $3,000,000, the percentage drops to slightly over 5 percent.

A lump sum fee is usually arrived at by negotiation between the client and the consultant. The engineer computes his direct costs, including all costs of assistance, office expenses, travel, subsistence, and out of pocket expenses and adds to this amount a percentage to cover his own charges.

The time basis of payment is particularly suited where special services are rendered, such as consultations, attending to legal cases, disputes and arbitrations, or modifying projects. In addition to charges based on time, consultants are usually reimbursed for other expenses, such as travel. South African consultants usually charge from $9 to $15 per hour, if the time basis of payment is used.

The employment of engineers on a retainer fee basis is a common practice for clients who wish to have the services of a consultant constantly available to them. The terms of agreement for services on a retainer fee basis vary widely. The charges may be based on a fixed sum, paid monthly or on some other mutually agreed basis, with daily or hourly rates in addition, for time spent at the client's request.

It is not uncommon in South Africa for foreign consultants to be called in, particularly where work of a highly specialized nature is concerned. The neighboring Central African Federation follows suit in this respect. There, the giant Kariba Dam scheme has called in French and British consultants instead of local men. Most work, however, is done by local men and one can say with confidence that there are far fewer foreign consultants called to South Africa, than there are South African consultants working in territories outside the Union. South West Africa, Portuguese East and West Africa, and British East Africa are typical examples of countries where South African consultants find work.

Consultants the world over, and of course, in the Union of South

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For Equipment Engineers

When You Push the Button . . .

ACTION BEGINS THROUGHOUT YOUR FAN SYSTEM

Even the best fan, properly installed, will provide smooth, efficient operation only when matched to the external system, with special attention to the following:

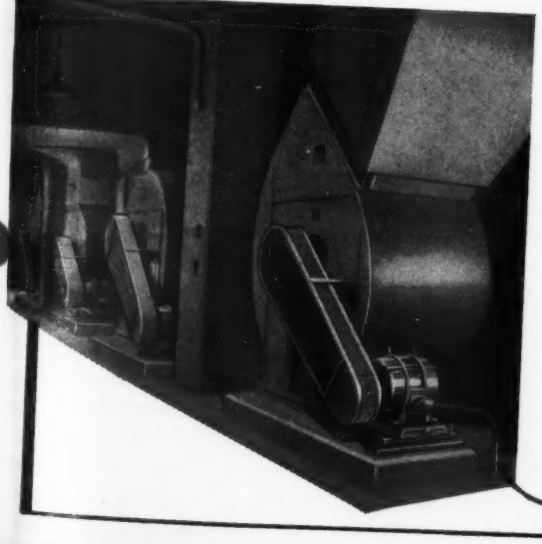
★ **DRIVE & RUNNING GEAR:** Check for correct wheel rotation, bearings running free and properly lubricated, belts or couplings accurately aligned and tight.

★ **MOTOR & STARTER:** See that protective devices are installed and in proper working order, motor not overloaded, controls functioning as desired.

★ **FAN SPEED:** R.P.M. should be measured and verified with name-plate data or written specifications.

★ **PRESSURE & VOLUME:** Take readings at essential points in system with manometer, pitot tube, velometer, anemometer, according to requirements.

★ **BALANCING SYSTEM:** Achieve required space conditions by means of adjustments provided in dampers, diffusers, vanes, and other system-control apparatus.



★ **PULSATION & VIBRATION:** Not necessarily fault of the fan; investigate mounting, supports, motor and drive balance, then recheck system and fan operating conditions.

★ **DUCTWORK:** Good workmanship is important. Noise or excessive losses may be due to loose joints, rough surfaces, improper bends, inadequate bracing.

★ **FINAL CHECK:** All appurtenances in place and adjusted, leaks or other defects corrected, foreign objects or materials removed.

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—with the added assurance of dependable performance when your air-handling equipment is furnished by BAYLEY.

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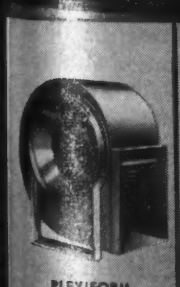
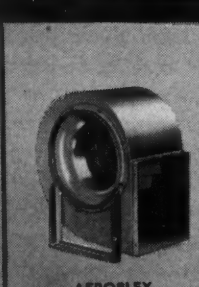
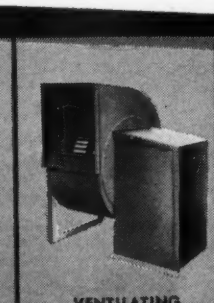
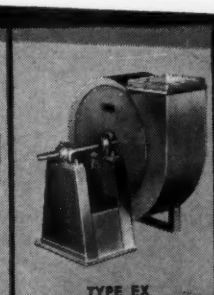
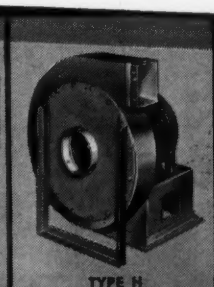

PLEXIFORM
Forward Curve


AEROPLEX
Backward Curve


VENTILATING SET


TYPE EX
Industrial Fan


TYPE H
Pressure Blower

Engineered
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Time to Talk it Over

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If you or one of your associates would be interested in joining this tour, mail us the coupon and we will send details of costs and current plans.

Tour Editor
CONSULTING ENGINEER
227 Wayne Street
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Africa, are necessarily in close working contact with manufacturers, contractors, and architects. From what I gathered, the relationship between these groups is extremely congenial. Architects advised me on fees paid by them to consultants. These fees are a matter of arrangement between the architect and his client "but in no case," to quote one member of the Institute of South African Architects, "shall the architect's fee be reduced by more than one percent on the cost of the work upon which the services of the consultant are engaged, provided always that the architect's fee on the cost of the whole scheme shall not be reduced by more than ½ percent." Each architect usually deals with a consultant of his own choice, unless his client demands the services of a particular engineering consultant. On one big hospital project, three consultants had been called in, one to advise on air conditioning, another on the structural aspects, and a third to advise on electrical installations.

During the present industrial boom, South Africa's consultants are being kept extremely busy. The papers are full of government and municipal tender notices, and consultants are busy designing, advising, and supervising municipal, government, and private ventures from small grain silos and swimming baths to large irrigation schemes and major chemical plants. Their association is a ready medium through which members can consult with each other on all matters of professional interest, and it affords a means by which the procedures of the consulting profession can be coordinated and handed on to those entering it.

The South African Association of Consulting Engineers keeps in touch with all matters affecting the profession and puts its advice and assistance at the disposal of members in any matters of difficulty arising in the course of their practice. Facilities exist for the government, public bodies, associations representing industry and trade, and others to confer with consulting engineers as a body and ascertain the collective views of men who are true specialists in their fields. ▲▲

A good start is a sure way
to maintain highest boiler efficiency

Cleaver-Brooks factory-trained servicemen instruct your operating personnel and adjust your boiler for peak efficiency. This service doesn't cost you a cent.

OTTO POLZIN is a typical Cleaver-Brooks factory-trained serviceman. He is shown on the job at Oilgear Co., Milwaukee, where he has just given two 125-hp Cleaver-Brooks boilers an initial start. Norbert Husting and Gordon Knischke of Oilgear are getting all the details on boiler operation and maintenance, including boiler blow-down procedure and tube cleaning.

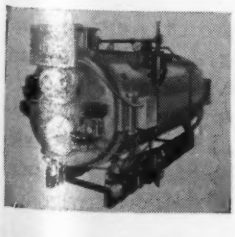
While on his "starting service call", Otto covered all of 32 items on his check list — such as the entire lubrication system, a CO_2 reading, inspected and cleaned relay points. In short, he *personally* made sure both boilers were "tuned" to perfection!

Cleaver-Brooks service is nationwide

This service is "standard practice" everytime a Cleaver-Brooks boiler is put into operation. And, as thousands of owners know, a phone call to your local Cleaver-Brooks representative brings this and other specialized services when needed.

Factory-supervised starting is just one of many advantages of being a Cleaver-Brooks boiler owner. You get the ultimate in modern boiler design: forced draft with four-pass construction, hinged or davited front and rear doors for fast cleaning, 10-second gas or oil interchange — just to name a few features.

Get the full story on the complete line — sizes from 15 to 600 hp; 15 to 250 psi. Call your nearby Cleaver-Brooks representative or write direct. Cleaver-Brooks Company, Dept. K, 320 E. Keefe Ave., Milwaukee 12, Wisconsin, U.S.A. Cable Address: CEEBEEWEST — all codes. Ask for catalog AD-137.



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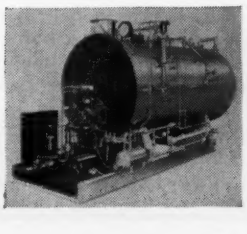
MODEL LR — Standard of the industry for steam or hot water service in heating or processing applications. Sizes: 200 to 600 hp.



Cleaver-Brooks®

TWENTY-FIVE YEARS OF LEADERSHIP
BY THE ORIGINATORS OF THE SELF-CONTAINED BOILER

Notes FROM ABROAD

Pure Water for Paraguay

Construction is expected to begin late this year on a $9 million modern water system for Asuncion, Paraguay, providing pure water for its 250,000 population. Financing of the project was made possible through a $7 million loan by the Export-Import Bank to the government of Paraguay, which will underwrite the balance of the cost. The Miami, Fla., engineering-architectural firm of Rader and Associates designed the system.

Port Mechanized

The $3.5 million port development project at Puerto Bolivar, Ecuador, now nearly complete, includes new mechanical loading equipment and other modern port facilities that are designed to reduce damage to bananas, of which Ecuador is the world's largest exporter. Rader and Associates, of Miami, Fla., designed the facilities under authorization of the Board for Reconstruction in the Province of El Oro.

Railroad for Columbia

The New York engineering firm Madiga-Hyland South American Corp. has estimated that the total cost of the 469 mile long "Atlantic Railroad" in Columbia, S. A. will cost about $80 million. The firm is acting as consultant on the railroad, which was started in 1953, and is expected to be completed sometime in 1958.

The new road will provide direct access to the ports of Barranquilla and Santa Marta on the Caribbean. Presently, freight is hauled to the Pacific Coast and then transported through the Panama Canal or is put on stern wheelers and carried up the Magdalena River — taking as long as two months from Bogota to the Caribbean ports.

The rail line project also includes construction of 60 all steel bridges, two of which will be over 1000 ft long. Madigan-Hyland has recommended a $40 million capital improvement program to revitalize Columbia's present 1600-mile rail system so that the country can realize maximum economic benefits from the line.

Moselle Canal

The French and German governments are expected to ratify a treaty that will enable the two countries to proceed with the development of a Moselle Canal connecting Lorraine, the Saar, and Luxembourg to the Rhine, the Ruhr, and North Sea ports.

Plans are to deepen and broaden 169 miles of the shallow Moselle River between Metz and Koblenz to make it navigable for 1500-ton Rhine barges and boats. Thirteen dams will be constructed along the course of the canal: nine in Germany, two on the frontier between Luxembourg and Germany, and two in France. Germany will build ten hydroelectric plants along the canal to produce a total of 750 million kwhr of

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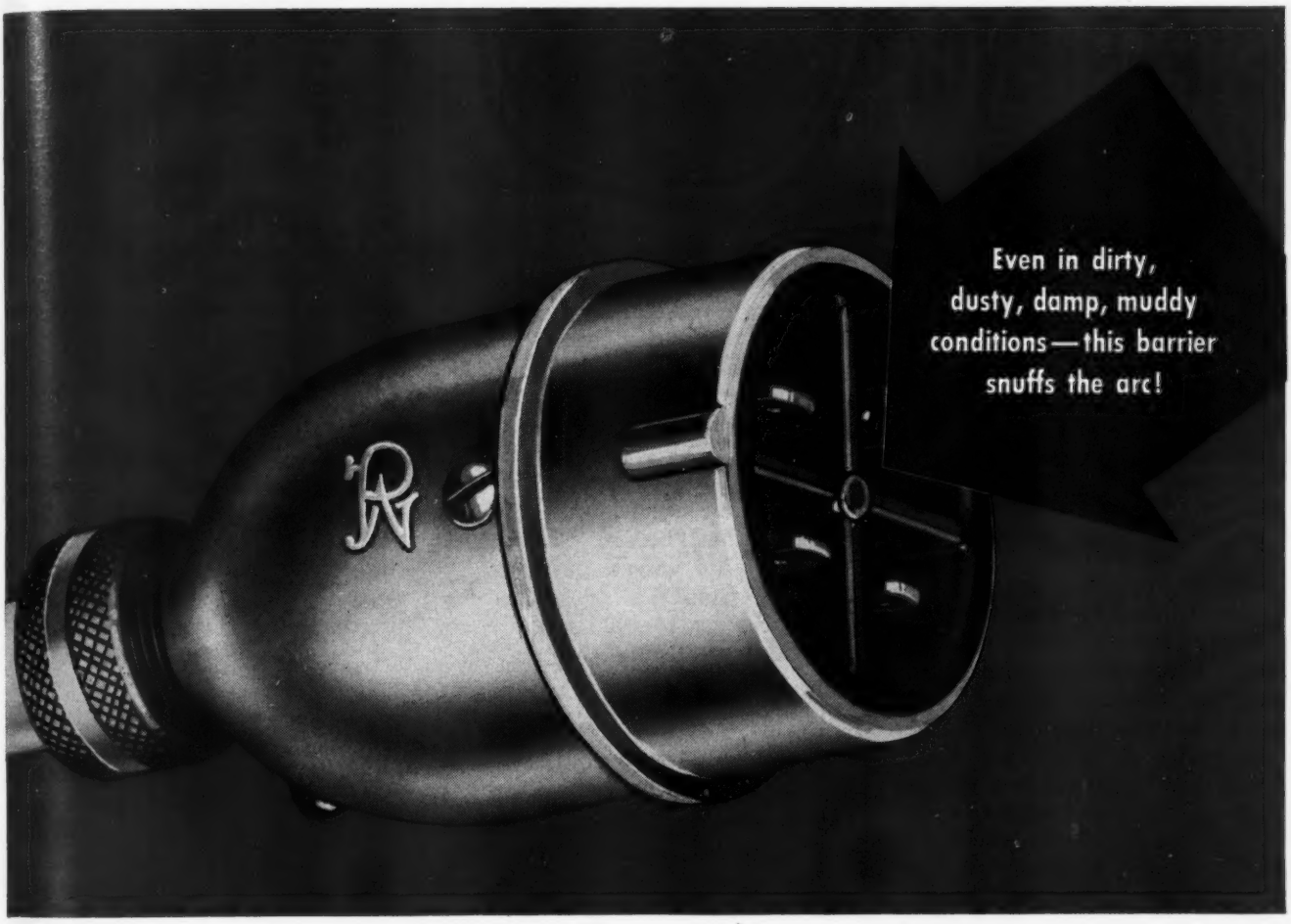

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QuelArc has insulating paths several times longer than any other connector. Dirt or moisture accumulations won't affect their efficiency.

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IT COSTS NO MORE to be sure with QuelArc's extra precautions.

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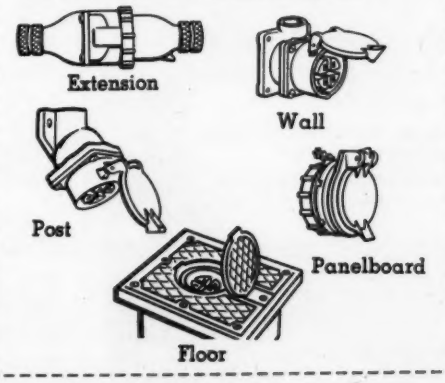
QuelArc Current Rupturing Connectors
UL Listed—600 Volts AC, 250 Volts DC
20, 30, 60, 100 and 200 Amperes



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*the original cellular steel floor

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electricity a year. The total cost of the project will come to about $130 million.

Meteor Trails Transmit Signals

The project "Janet," a promising new communications technique that uses the trails of single meteors to transmit messages over long distances, has recently been declassified by the Canadian Department of National Defense. Dr. P. A. Forsyth and his associates at the Radio Physics Laboratory, at Shirley Bay, near Ottawa, proved that the trails of charged particles left behind by meteors reflect radio waves, making possible transmission of signals for distances up to 1000 miles.

The system employes frequencies previously used for short distance transmission such as television broadcasts. Equipment at the sending and receiving ground stations employs computor or electronic brain techniques to transmit or pick up messages. When the sending circuit senses a suitably located meteor trail in the upper atmosphere it automatically transmits its stored message to the receiving end of the circuit. Since the transmission speed is too high to be received by teletype equipment, incoming information is stored in the computor or brain and printed at normal speeds during intervals between transmission bursts.

Signals reflected from the trails are largely independent of ionospheric conditions such as disturbances caused by the aurora borealis.

Canadian Consultants To Aid India

India will get financial and engineering assistance from the government of Canada, under the Colombo Plan, on the new hydroelectric project on the Kundah River in the state of Madras. The first stage of the project, which will be completed in 1960, calls for construction of three dams on the adjacent Emerald, Avalance, and upper Bhavani Rivers and two power plants on the Kindah River, supplying a total of 145,000 kw of electricity.

Canada's contribution will cover up to $20 million of the external costs. It will include provision of turbines and generators and other power house equipment, substation and transmission equipment, and specified materials and construction equipment for the civil works. Canada will also provide services of Canadian consulting engineers to supervise certain aspects of the work.

Metal Fuels for Ore Reduction

The Hoesch Works, Dortmund, Germany, has developed a new process to automate steel production. Heart of the process is a specially constructed furnace able to reduce iron ore directly to steel with the aid of metal fuels (aluminum-silicon alloys). The process can be adjusted to produce various types of steel.

Zircon Sheet

The German Krupp Works is producing a new sheet metal from zircon that is resistant to hydrochloric acid, lighter than steel, and slightly heavier than titanium. Since it serves as a neutron filter, zircon is used for "windows" in nuclear reactor construction and also in construction of radio tubes.

Krupp is entering into development of new metals to offset loss of steel production under the firm's agreement with the Allies. Last year, Krupp became the first firm on the continent to go into production of titanium.

U. S. Engineers Plan Pakistan Dam

Under a $3.5 million contract with the Government of Pakistan and the International Cooperation Administration, the International Engineering Company, of San Francisco, will provide construction designs and operation plans for a $68 million multi-purpose dam in East Pakistan.

International Engineering will send a staff of American technicians to Pakistan to prepare necessary designs and construction drawings, study previous reports and data, supervise further investigations, establish a construction schedule, test operations of the dam, and train Pakistani personnel.

The new dam, to be built on the Karnafuli River, 30 miles up-

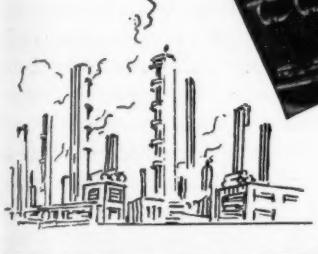
THIS 400,000 Pounds per HOUR

Vogt

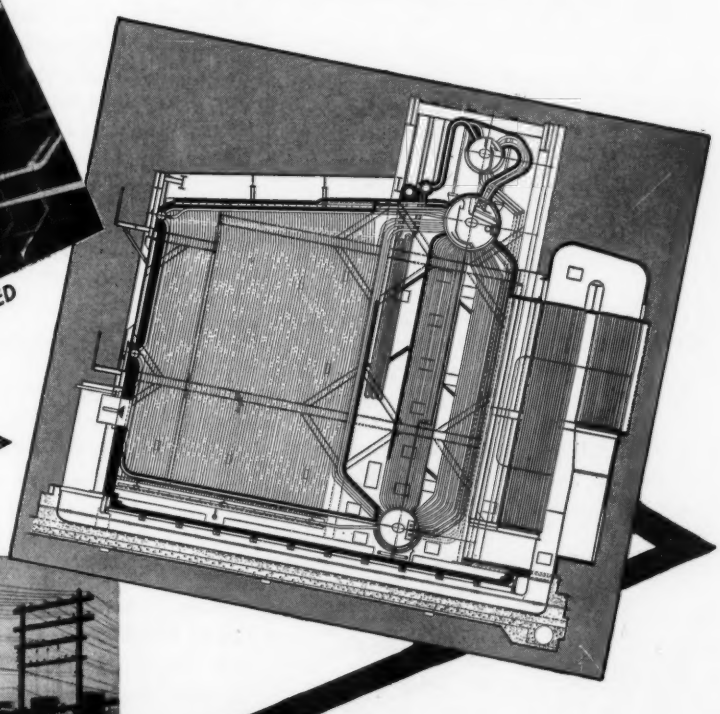
STEAM GENERATOR

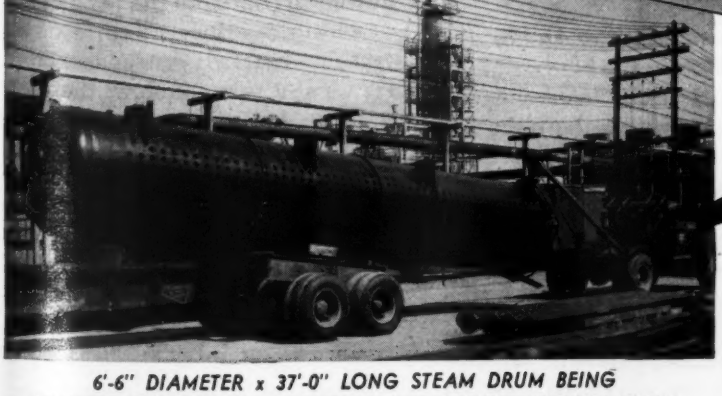
Gives Top Performance in a Leading Texas Petroleum Refinery

VIEW OF THE COMPLETED STEAM GENERATOR



RIGHT →
LONGITUDINAL SECTION THROUGH THE UNIT.





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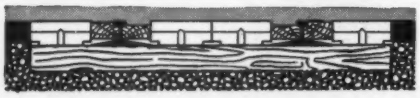

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stream from Chittagong on the Bay of Bengal, will provide East Pakistan with low cost electric power for industries and homes.

The Government of Pakistan already has spent more than $10 million for equipment, excavation of the dam site, and other preparations for construction, and will supply the necessary local currency financing—a total estimated at about $30 million.

ICA now has made available or approved for use on the Karnafuli project a total of $12.7 million. It is estimated that an additional $25 million in foreign exchange will be required to complete it.

Engineering Aid to Lebanon

The International Cooperation Administration has made $3.67 million available to help Lebanon improve its public road and transportation system. Of these funds, $3 million will be used to help the Lebanese Government finance construction of a section of highway which runs from Beirut, Lebanon's capital, to Damascus, the capital of Syria, and $200,000 will be used to finance a contract with an American firm to send technicians to Lebanon to advise on engineering and construction. The remaining $470,000 will be used to help rehabilitate and improve safety conditions at Beirut International Airport.

A Nose for Leaks

The Municipal Gas Undertaking of Utrecht, in the Netherlands, has found it faster and cheaper to use dogs rather than instruments for detection of leaks in underground gas mains. It takes a training period of three months for dog and guide to learn the art of leak detection.

The dog can inspect about 760 yards of pipe in 50 minutes and dogs have been known to turn aside from the indicated path in order to point out leaks in branch pipes. Some deductions about the extent of the leak can be made from the dog's reaction. For small leaks the dog stops and stands still; for larger leaks the dog barks; and for very large leaks the dog scratches at the ground.

The use of dogs is not recommended if the gas flows away through sewers or if leaks are located under a paved road.

Reinforcing Bar Location

An instrument for determining the location of reinforcing bars in hardened concrete has been developed at Tekniska Rontgencentralen AB (Technical X-ray Center) in Stockholm, Sweden. The instrument consists of an electromagnet that operates on ac. Some of the magnet's lines of flux pass through the concrete and the reinforcement, so that the instrument shows a maximum amplitude when it is placed directly over and parallel to the reinforcing bar. Since the amplitude is inversely proportional to the distance from the bar, distance and orientation of the bar may be computed. Accuracy is $\pm 1/4$ in. when the diameter of the reinforcement is known.

Liberian Highway

Under the supervision of Brown and Blauvelt, New York consulting engineers, construction will begin this fall on a new 150-mile highway in the interior of Liberia, Africa. This project is part of a mutli-million dollar highway program designed to improve transportation between inland and coastal towns. It is financed within the aid of a $12 million loan from the U.S. Export-Import Bank.

Two to three years will be required to complete the project due to the undeveloped nature of the terrain. Initially, transportation from point to point along the route will be by airplane, with communication by radio.

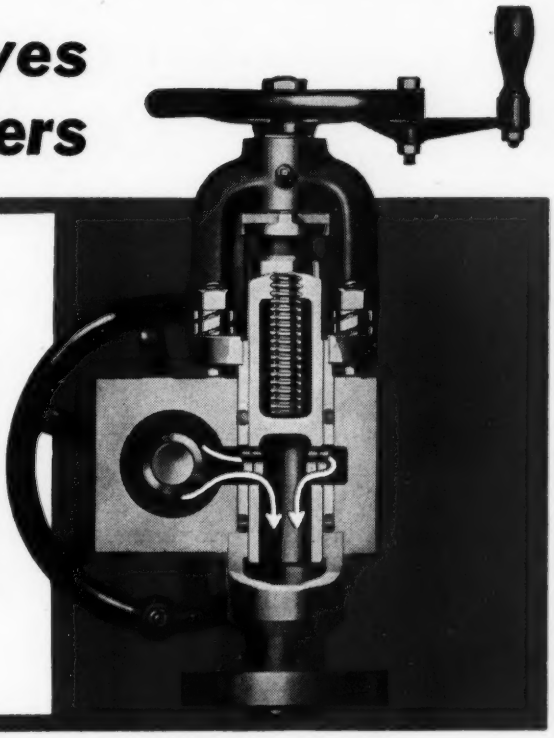
The new highway will open for development large areas that are now tropical jungle. It will provide access to known mineral resources and timber, and is expected to help stabilize food prices within the country.

Low Cost Insulation

A new type of low cost insulation developed in England for large buildings consists of gypsum plasterboard surfaced on both sides with a veneer of aluminum foil. Used in an aircraft hangar, no interior decoration was needed, illumination was improved, and the board acted as a vapor barrier.

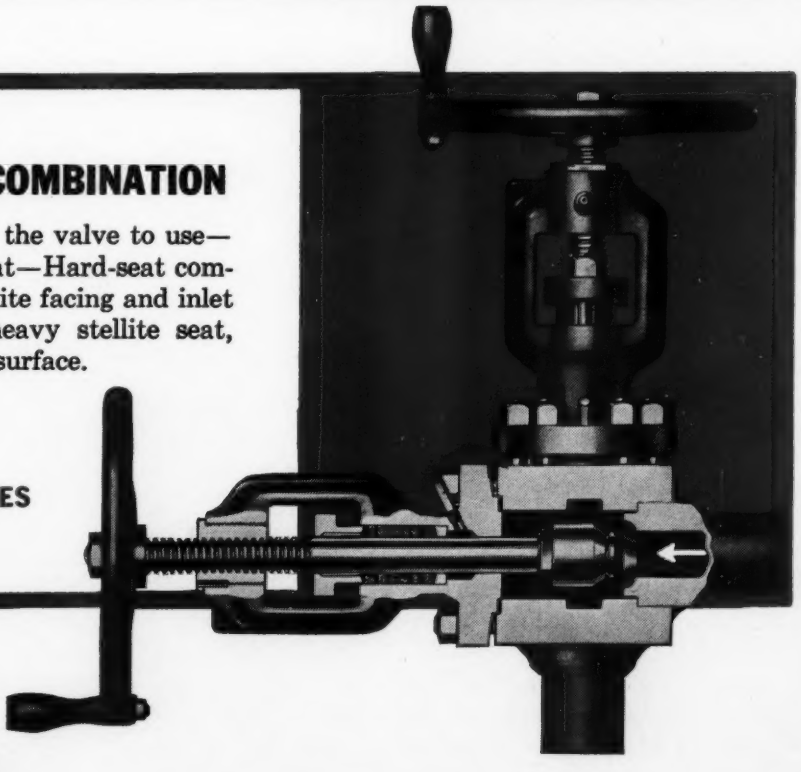
UNIT TANDEM

rugged blow-off valves for high pressure boilers



HARD-SEAT—SEATLESS COMBINATION

■ For boilers up to 1500 psi, this Yarway Unit Tandem Blow-Off Valve offers the maximum in dependable service. A one-piece forged steel block serves as the common body for the Yarway Stellite Hard-seat blowing valve and the Yarway Seatless sealing valve. All interconnecting flanges, bolts and gaskets are eliminated. The Unit Tandem at right is sectioned through Seatless Valve to show balanced sliding plunger in open position and free flow.



HARD-SEAT—HARD-SEAT COMBINATION

■ For boilers to 2500 psi, this is the valve to use—Yarway's Unit Tandem Hard-seat—Hard-seat combination. Disc has welded-in stellite facing and inlet nozzle has integral welded-in heavy stellite seat, providing smooth, hard-wearing surface.

OVER 4 OUT OF 5
HIGH PRESSURE PLANTS
USE YARWAY BLOW-OFF VALVES

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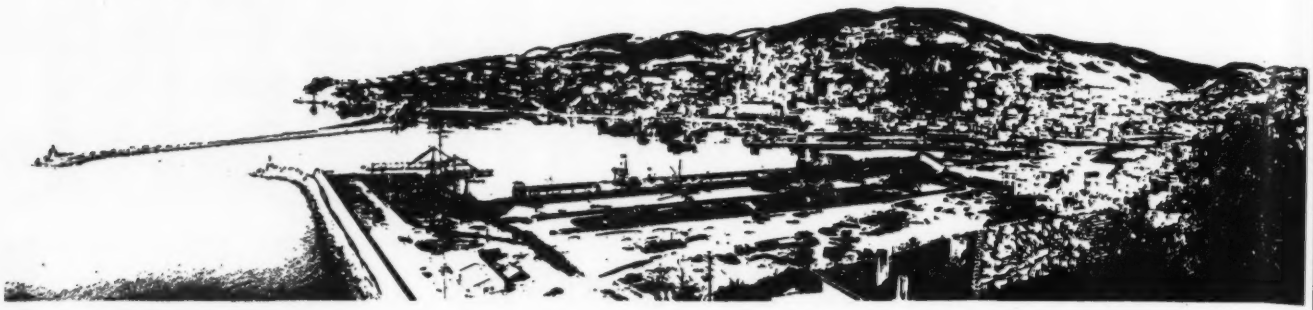

Zonguldak--A Foreign Project Report

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ASAF YENISEY
Eregli Komurleri Isletmesi

IN TURKEY, mining, power, roads and transportation, agriculture, and manufacturing are all in the throes of ambitious face-lifting and expansion programs. Probably the largest single capital project underway is the development of the Zonguldak coal field on the coast of the Black Sea, some 255 kilometers by sea from Istanbul, and 485 kilometers by rail from Ankara, the capital of the country.

Coal production in the Zonguldak field is entirely a government enterprise. Eregli Komurleri Isletmesi (more familiarly known as "EKI"), the operating organization, presently employs 32,700 people. Of these, approximately 2000 are classed as administrative and clerical, 16,000 to 17,000 as underground workers, and 13,000 to 14,000 as surface workers. The field is the only known producing source of metallurgical grade coking coal in Turkey, and is a major source of solid fuel for much of the country's industry. These coal resources and their development constitute an important element in the nation's industrial future and economic development.

Discovery and Early History

At the beginning of the nineteenth century Sultan Mahmud II was faced with the problem of finding a source of fuel to supply the needs of the Turkish navy, the mint, ordnance plants, and seaports. Coal in small but precious quantities was imported from foreign sources, but supply was uncertain and the cost was high. Small pieces of this coal were given to discharged sailors, who were told to search their home provinces for rocks of a similar nature.

In 1822, one of these sailors from the village of Eregli Kestaneci, on the coast of the Black Sea, brought to Constantinople (Istanbul) the first samples of "black stones" to be reported. The black rock was said to be coal, and Mahmud II gave him "five bags of coins." The discovery was ignored.

In 1829, another sailor, named Uzun Mehmet, from the same village, reported a second find. He was rewarded with a monthly pension of 600 kurus for life, and this time the discovery attracted more attention. As a matter of passing interest, one kurus was worth approximately 25 cents in 1829. In 1955 the official value of one kurus is about a third of a cent.

Since its discovery, the Zonguldak coal basin has had a checkered career. From 1848 to 1914, coal production, while government controlled, was carried out for the most part by private interests, both Turkish and foreign. At one time, under the Royal Treasury, skilled miners were brought in from Serbia and Montenegro. From 1865 to 1914, besides Turkish capital, foreign interests in the Zonguldak coal basin included Greeks, Italians, Armenians, Belgians, Germans, Czarist Russians, and French. Adverse Turkish public opinion forced the Russians to abandon their project before it matured. French and Italian interests were perhaps most prominent.

Recent History

During World War I Zonguldak was organized as a War Coal Center with a German colonel in charge. Roads and railroads to Zonguldak were nonexistent, and the Black Sea was controlled by the Russian fleet, which repeatedly shelled Zonguldak harbor and shore installations. As a result, production fell from 904,000 tons in 1911 to 158,000 tons in 1917.

After the Turkish War of Independence the new National Government took a hard look at the grow-

ing importance of the coal problem. New laws bearing on the situation were passed, students were sent abroad to acquire education and experience in mining, and a mining school (later converted to a mining vocational school) was established in Zonguldak in 1924.

Government Ownership

After unsuccessful attempts to encourage development of the coal field by private interests, the National Government decided to take more direct action. In 1936 all mines under French ownership were purchased by the Turkish Government. The Etibank (a government bank) was charged with management of the coal concessions and established EKI as the subsidiary operating management. At that time some mines still remained under private ownership, but by 1940 all mines and installations had been purchased by the government.

EKI was faced with the problem of increasing production as rapidly as possible to meet immediate consumer demands and at the same time preparing the coal field for long range sustained production at a level consistent with expected expansion of the general economy of the country. These were the basic objectives of the development program. Initially it was hoped that the tonnage goals set would permit exportation of up to a million tons annually to certain European and Mediterranean markets. Rapidly increasing internal demands for fuel now makes such exportations a highly unlikely possibility, at least in the immediate future.

Undeveloped Field

In 1939 the Zonguldak field produced 2,700,000 tons of run-of-mine coal and was poorly prepared for any substantial, sustained increase. Production could be—and eventually was—increased to about 4,000,000 tons on a short term basis, but within a few years most of the more easily accessible coal would have been mined out, and the steeply pitching and badly faulted seams required extensive and costly development in depth. Underground and surface facilities and handling, preparation, harbor, and transportation equipment were for the most part old, tired, or inadequate. Electric power was limited, and the housing situation was far from satisfactory. Coal reserves were poorly defined.

Production was derived from 31 separate mines, the smallest producing 5 tons and the largest 1550 tons per day. Eleven small and inefficient coal preparation plants were in operation, ranging in capacity from 10 to 100 tons per hour.

Birth of the Program

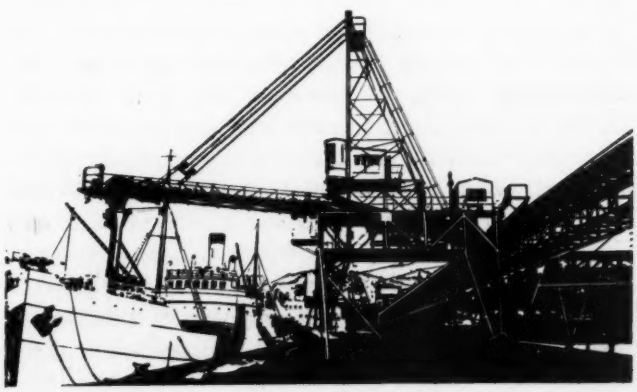
Private capital showed no interest in developing or expanding the industry. Immediately after nationalization of the coal field, in 1940, steps were taken by the government toward a more thorough investigation of reserves. Local engineers drafted a preliminary development program setting forth capacities of mines to be developed, levels to be mined, and general methods of exploitation. It became evident, however, that the expressed concept of operating methods was conservative and did not take full advantage of the inherent possibilities of modern mining equipment and methods. Extensive use of electricity underground had not been contemplated, and a further revision and consolidation of plans for surface facilities was considered advisable. Progress was interrupted by World War II.

Immediately after the war the first development plan was revised by EKI in collaboration with the American firm, Parsons, Brinckerhoff, Hall and Macdonald. Further revisions were made based on the proposals and advice of other American firms including the Parsons group; Raymond Concrete Pile Co.; Dingle Clark Co.; Heyl & Patterson, Inc.; McNally Pittsburgh Manufacturing Co.; Evanson & Auchmuty; and the late L. E. Young. A final, four-month review of plans and proposals was made by EKI and Paul Weir Co., engineers, and an approved program finally was accepted for execution.

In the meantime the electric power situation in Turkey was receiving active attention. A new coal-fired electric power generating plant of 60,000-kw capacity was completed in November, 1948, at Catalagzi, in the heart of the Zonguldak coal field. The capacity of this plant now is being doubled to 120,000 kw, with the additional 60,000 kw to go on the line during 1956. While electric power plays an important part in the development of the coal field, the power plant itself is not included in the cost or scope of the mine field development program.

Execution of the Project

Actual start on the development project was made possible in 1949, with the advent of the Marshall Aid Program. Three American firms of consulting engineers were called in to assist in execution of the project: Frederick Snare Corporation, on construction of the Zonguldak harbor; Paul Weir Company, on execution of all other surface and some of the



COAL LOADING FACILITIES AT ZONGULDAK HARBOR.

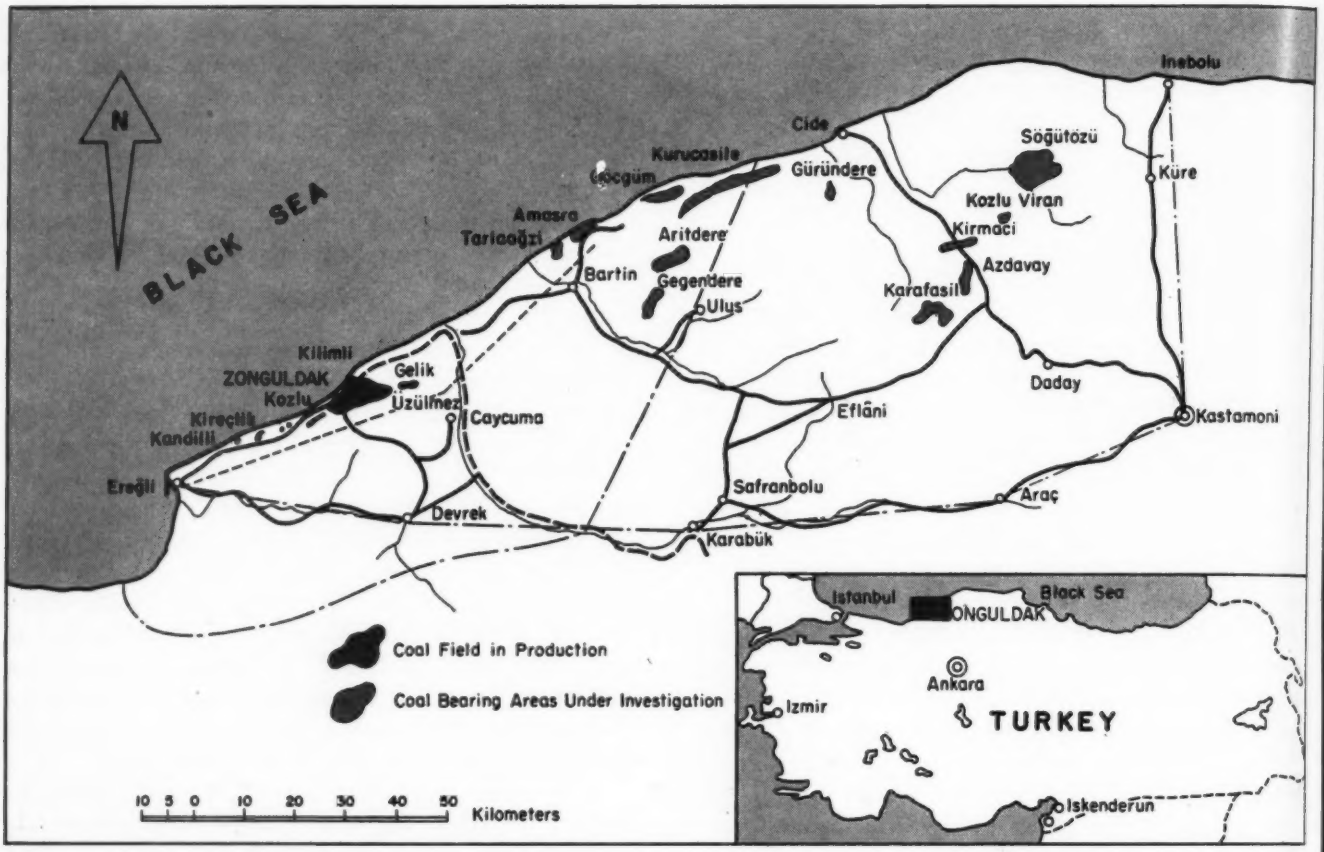


FIG. 1 — MAP SHOWING COAL FIELDS IN PRODUCTION AND UNDER INVESTIGATION BETWEEN EREGLI AND INEBOLU.

underground installations; and Koppers Company, on control of construction work. Later in the program upon termination of the Koppers' contract, Paul Weir Company also was charged with advisory responsibilities with regard to construction work.

The Planning and Engineering division of EKI is responsible for carrying out the development program. Specifications, engineering, and planning for individual projects or installations are prepared by this department in collaboration with Paul Weir Company, engineers, and submitted to the general management for final approval.

On each major project a contract is let to a foreign firm for the manufacture and supply of equipment and machinery on the basis of competitive bids. Almost all equipment and machinery is being purchased from Germany, England, the United States, and France. Construction and civil engineering work occasionally are done by EKI itself, but more frequently are let to a private Turkish contractor. In three instances construction contracts were awarded to foreign firms: to the Netherlands Harbor Works for construction of the Zonguldak harbor; to Cementation Company Ltd., of England, for sinking five shafts; and to Hamilton Overseas Contracting Company, of the United States, for driving development rock galleries at the Kozlu mine —300 meter level.

Examination of bids, approval of detailed plans, and coordination of all work on the program is carried out by the Planning Department of EKI, in collaboration with Paul Weir Company.

Reserves and Production

Between Eregli and Inebolu (Fig. 1) the North Anatolian coastal range is built up by folded and faulted Mesozoic rocks. Present knowledge indicates that a belt of coal-bearing Carboniferous underlies the Cretaceous over a distance of approximately 160 kilometers, appearing on the surface where the younger formations have been eroded. In places the Carboniferous is not present, and a continuous productive zone of coal below the Cretaceous cannot be expected.

At present only the Kandilli and Zonguldak-Kozlu areas (Fig. 1) are in production, and the development program is confined to these areas—by far the major portion being concentrated in the Zonguldak-Kozlu basin. Investigation of other possible exploitable areas from Amasra to the east are underway.

No really accurate evaluation of reserves can yet be made even in the presently productive areas. The geology and stratigraphy of the region is complex, and formations are badly faulted and, in places, steeply pitching. Some concept of the unfavorable natural conditions can be gained from Fig. 2 which shows a section through the Zonguldak-Kozlu basin

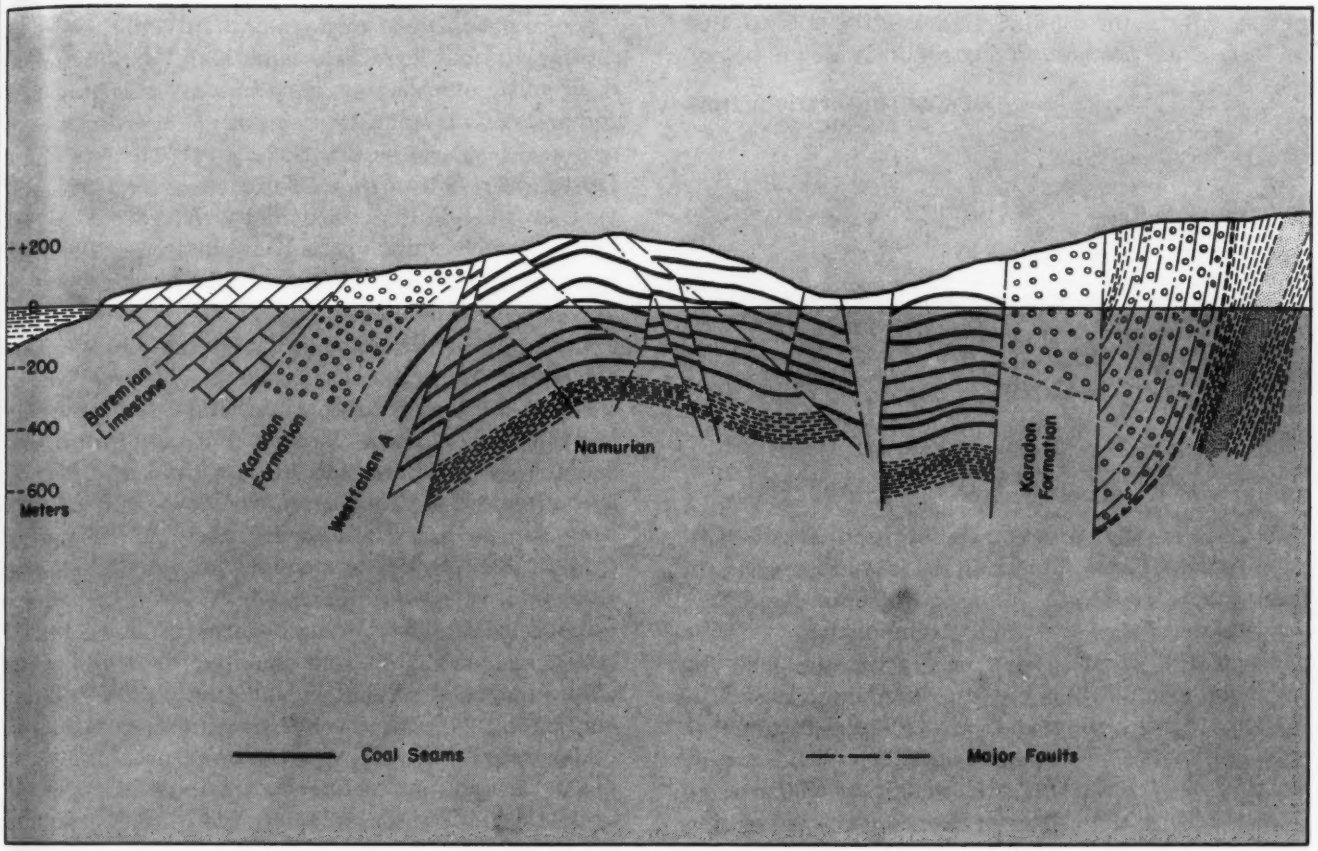


FIG. 2 — TYPICAL SECTION, ON NORTH-SOUTH AXIS, THROUGH COAL FIELD JUST WEST OF THE CITY OF ZONGULDAK.

on a North-South axis just West of the city of Zonguldak.

In the light of current knowledge, reserves in the presently producing areas are estimated as follows:

RESERVES — THOUSAND METRIC TONS

Horizon (meters) Below Sea Level	Proven or In Sight	Additional Probable	Additional Possible	Total
		Kandilli Area		
to –400	30,000			
to –800		38,000		
		Zonguldak-Kozlu Area		
to –400	333,000			
to –600		253,000		
to –1000		169,000	105,000	
to –1200			148,000	
	363,000	460,000	253,000	1,076,000

Topography in the mining area is mountainous, and the narrow valleys offer little terrain satisfactory for mine sites and surface installations. For the most part surface plants are on filled or excavated ground.

Coal Characteristics

The coals of the Zonguldak basin are ranked as bituminous. Because of their friable nature, a large percentage of production is in the finer sizes, and the cleaning and recovery of these fines is a major part of the coal preparation problem.

The coals of the Zonguldak-Kozlu area are medium volatile, strongly coking, nonswelling, and low in sulphur. Ash content of the run-of-mine product, however, is in the range of 20 to 38 percent. The coals are presently cleaned to 14-percent ash, but can easily be prepared to 10 to 11-percent ash at an economic recovery level.

The Kandilli area coals are high volatile and good gas coals. Ash content as mined ranges from 15 to 25 percent. These coals are more easily washed than those from the Eastern area although the sulphur content is slightly higher.

Seam Thicknesses

The number of coal seams appearing in the geologic column varies throughout the field. In the Kandilli area two seams are mined, the thickness of each ranging from 4.00 to 6.00 meters and the inclination up to 90 degrees. In the Zonguldak-Kozlu area as many as 17 seams are exploited in one mine, and in the area as a whole, individual thickness of seams now mined ranges from 80 centimeters to 8.00 meters with inclinations from flat to 90 degrees. Average seam thickness in any one mine (total thickness divided by number of seams) in this area varies from about 1.40 meters at the Gelik mine to about 2.20 meters at the Asma mine.

In the entire Zonguldak field about 42 percent of total production is derived from seams with thick-

nesses within the limits of 80 centimeters to 1.50 meters. Coal production figures are shown below.

YEAR	RUN-OF-MINE PRODUCTION IN METRIC TONS
1875	142,000
1914	651,000
1917	158,000
1920	569,000
1925	950,000
1930	1,595,359
1935	2,340,491
1940	3,019,458
1945	3,718,772
1950	4,360,598
1955	5,495,697
1956	5,933,000 Target
1957	6,472,000 Target
1958	7,116,000 Target

Elements of the Project

The following breakdown is used on an administrative level to facilitate better control of engineering, purchase, and construction, and will provide an idea of the project components.

New Mine Shafts. Five new concrete lined circular mine shafts 6.5 meters in diameter will be sunk to depths ranging from 470 to 640 meters—plus one shaft 4.5 meters in diameter and 420 meters deep. Total length of shaft sinking is 2530 meters.

Kozlu Mine Development. In general this includes surface, shaft, and underground facilities and equipment for development of the existing Kozlu colliery to mine in depth and sustain a production of 5500 tons per day. This includes complete hoisting installations for two shafts, coal and material handling facilities on the surface and underground, and all necessary surface structures including railroad loading facilities. Also included are three electric, twin-unit mine ventilating fans with stand-by diesel power drives, each fan having a capacity of 210,000 cfm at 4-in. water gage; complete underground main pumping installations with a total installed capacity of 2500 hp; mine compressors; and necessary electric power distribution and substations.

Kozlu –300 Meter Level. This includes approximately 15 kilometers of rock galleries plus lining, development raises, permanent track laying, and miscellaneous excavation necessary to prepare this level for production. The cross sections of the development galleries vary, the largest having a clear finished inside area of 215 sq ft. In designing the development entries, close attention was paid to ultimate ventilation requirements and resulting power costs.

Karadon Mine Development. This is similar to the Kozlu mine development described above. The compressed air plant here will include electrically driven turbo-compressors with a total capacity of about 46,000 cfm, plus air line distribution systems.

Development Galleries, Karadon. This project will provide for 8.5 kilometers of rock galleries at the –164 meter level—in general similar to the Kozlu development galleries.

Armutcuk Mine Development. In general, this is similar to that at Kozlu and Karadon, including rock galleries, hoisting installations, pumping and compressed air plants, and power distribution. A new coal preparation plant of 200-tph capacity and a 150-tph aerial tramway 1800 meters long are also part of this mine development. Armutcuk is essentially a new mine in the Kandilli area rather than expansion and development of an existing mine as at Kozlu and Karadon.

Underground Haulage. This consists of complete electrified main haulage systems at three mines, using 15-ton trolley locomotives and 5-ton mine cars on 42-in. gage track. Traffic control systems and completely equipped loading stations are part of each installation. Total length of new main haulage presently projected is approximately 24 kilometers.

Mine Electro-Mechanization. As rapidly as possible and wherever applicable, mechanized equipment is being installed underground at all mines, including belt, chain, and shaking conveyors; portable compressors; cutting, drilling, and loading equipment; auxiliary ventilating fans; pumps; and underground hoists. Necessary underground electric power distribution networks are included.

Catalagzi Coal Preparation Plant. This includes a 500-tph coal washery including a 1000-meter belt conveyor system for refuse disposal; a pump system for disposal of sludge; and a section for the recovery of fine coal by flotation process with a feed capacity of 80 tph. Most of the coal from this washery is transported directly to inland consumers by rail.

Zonguldak Coal Preparation Plant. This consists of a 750-tph coal washery located at Zonguldak harbor. Adjacent is a five-track railroad car unloading installation capable of receiving and handling raw coal for the Zonguldak washery as well as washed coal and coke from other EKI plants at the rate of 40 tons per minute. The washery includes a belt conveyor system 2200-meters long for refuse disposal; a pump system for sludge disposal; and a coal flotation section with a feed capacity of 120 tph. Most products leave by sea, with some going inland by rail.

Karadon Transfer Station. At Karadon mine, there is an installation for receiving coal and rock in 20-car trips of five-ton mine cars, handling them automatically through rotary dumps, and transporting the material 1400 meters by belt conveyor system directly into the Catalagzi coal preparation plant. Capacity of this system is 650 tph.

Asma Transfer Station. The Asma mine transfer station is a duplicate of the Karadon station, except that a 550-meter belt conveyor system delivers material to a loading point on the railroad for transportation to the Zonguldak washery.

Zonguldak Harbor. This calls for construction of a complete harbor and extension of the old port to handle coal, mine timber, and general cargo. This

ncludes construction of two breakwaters with a otal length of 870 meters; one 125-meter quay for nine timber; a coal loading quay 500-meters long; 200 meters of quay for general cargo; 1,500,000 cubic meters of dredging; and 550,000 cubic meters of fill. Two diesel tugs, a dredge, and a vessel for loading bunker coal into ships will be added to augment port services.

Shore Installations. At Zonguldak Harbor the shore installations include complete facilities for handling washed coal from the Zonguldak washery into stock piles, from stock piles into ships, or directly from washery to ships. The same installation will handle washed coal and coke brought into the harbor by railway from other EKI plants. Three ship loaders can handle up to three ships at one time. Capacity of each ship loader is 500 tph.

Two traveling gantry cranes are provided to handle mine timber from ships to quay and from quay to railroad or trucks. Approximately 200,000 cubic meters (85 million board-feet) of mine timber is delivered to Zonguldak annually by ship, mostly from foreign ports. Equipment for the cargo quay includes a 15-ton traveling crane, a 5-ton crane, and warehouse facilities.

Eregli Harbor Loading Facilities. A complete installation is scheduled for Eregli harbor to receive washed coal from railroad cars originating at Armutcuk (Kandilli), and transfer it to stock piles, directly to ships, or from stock piles to ships.

Water Supply Systems. One complete water supply system, including impounding dam and reservoirs will supply industrial water to Zonguldak coal preparation plant and two mine plants. A moderate quantity also will be purified for domestic use.

A second independent system including collecting wells and reservoirs will supply water primarily to the Catalagzi coal preparation plant, plus sufficient quantity for domestic use in one mining district.

Standard Gage Railroad. A new EKI operated standard gage railroad system will connect Zonguldak harbor and coal preparation plant with the mines in three districts and with the existing State Railway yards at Zonguldak. Sidings and yards at the Catalagzi coal preparation plant are a part of this project. Essential elements of the system include 30 kilometers of track and roadbed; five railway bridges and three highway bridges; one elevated highway overpass and connecting ramps; complete railway traffic control system; 7 diesel locomotives; 110, 50-ton cars; and a locomotive repair shop.

Transformer Substations. The EKI internal power network is being expanded to meet the demands of the development program. Installation of transformers and switchgear with a total capacity of 56,000 kva will provide power distribution in three principal operating areas.

Electrical Repair Shop. A central shop will be provided for major repairs of all electrical equipment in the Zonguldak area. Existing mechanical repair shops are being expanded and modernized.

NEW SHAFT AND HEADFRAME AT THE KOZLU MINE.

Prospecting. Underground prospecting work and drilling in two new areas will ascertain coal reserves and mining conditions.

Housing and Labor Welfare. A crucial problem in coal production in the area is the availability of permanent workers. Labor turnover is high, and workers must be recruited periodically from villages in the Black Sea coastal area. This problem is being attacked by improving present worker's lodgings, constructing new housing for 4000 families, improving roads, extending present medical and hospital facilities, and building a 150-bed sanatorium for miners afflicted with tuberculosis or silicosis.

Flood Control. Almost all mine installations are located in narrow valleys in mountainous country. Projected flood control work includes diversion or regulation of streams, retaining walls, and provision of extensive surface drainage systems.

As part of the development project, EKI is carrying out concurrent programs on preventive maintenance work, safety, foreman and worker training, first aid, and mine rescue. These programs are considered an essential part in attaining objectives.

Targets, Costs, and Schedules

The major part of the development program should be completed by 1957, with some phases extending into 1958 and 1959. Total cost of the program was estimated at $144,000,000 on the basis of 1953 evaluations. Of this total, approximately 59 percent represents Turkish currency expenditures, and 41 percent foreign exchange requirements. Final Turkish lira costs undoubtedly will be somewhat higher than estimated, although foreign exchange requirements remain pretty well in line.

To the end of 1955, expenditures were $45,000,000 in foreign exchange provided through United States Government foreign aid agencies (45 percent in direct aid, and 55 percent in EPU financing), plus the equivalent of $79,000,000 in Turkish currency. Many of these installations are in operation. ▲▲

Prebuild for Future Needs--or Defer?

HENRY B. BACKENSTOSS, Jackson & Moreland, Inc.

Henry B. Backenstoss studied first at American University, Washington, D.C., and later he earned MS and BS degrees in EE at Massachusetts Institute of Technology. He then spent a year with Anaconda Wire & Cable Co. before joining Jackson & Moreland, in 1936. Starting as a junior engineer, he has served in successive positions leading to his present post as project manager. He is a licensed P. E. and a member of Tau Beta Pi, Sigma Xi, and AIEE.

IN PLANNING new construction to meet a client's immediate need, it is not unusual to find that this need is expected to increase in the future. In outlining the immediate project therefore, the planner must decide whether to anticipate the larger future need and, if so, to what extent. The future need may take various forms. Perhaps it is extra space for future growth, flexibility to accommodate expected changes in manufacturing process, or some other type of freedom to meet requirements not presently at hand. It does not have to be met in the immediate construction, and the planner has the option of waiting to satisfy the future need until the time it arises.

The inherent advantage in prebuilding for a future need is that it often can be accomplished at a favorably low cost because it is done incrementally to a committed construction program. The same features, if deferred and added by later modifications, would cost much more. The drawback is that the required extra investment, favorable though it may be, must be carried unproductively until the future need develops. The choice in this dilemma requires an economic study to determine which of the two courses provides the lowest long-range cost to the client.

The economic study suitable for solving the prebuilding problem must consider not only immediate costs but expected future costs. Future costs cannot be treated satisfactorily by judgment alone in selecting the program of lowest total cost. Judgment is subjective and not usually impartial. The aims of effective and economical planning, therefore, may not be fully achieved.

Future costs must be treated more exactly if best results are to be obtained. A method for doing this, sometimes called the present worth method, is to apply suitable discount or present worth factors to future costs in order to express them in terms of current dollars. By bringing present and future costs to the same base, sound mechanics are established for determining the total long-range costs of the alternative programs.

A simple example will be helpful. Suppose that a manufacturer planning a new building has fixed its size in the light of his present requirements and has estimated its cost. Suppose also that he expects an increase of 50 percent in space requirements in the foreseeable future. The extra cost of constructing a building large enough to meet his future needs rather than the smaller building for immediate needs would be his cost of prebuilding. Presumably the extra space could be obtained attractively at a lower than average unit cost. The cost of providing the extra space by adding to the smaller building when the future need actually developed would be his cost of deferring. This presumably would involve a higher than average unit cost.

Equations

Comparison of these alternatives to determine which has the lower cost throughout its useful life is not difficult. In fact, the general mathematical expressions needed by the planner who must choose between prebuilding or deferring can be developed readily from this illustration. Fig. 1 shows graphically the investment-time relation. The investment cost for the smaller building is represented by the large base area designated "Investment for Facility to Serve Immediate Need Only." The cost of prebuilding, that is, the extra investment cost for a building designed to accommodate future needs, is the crosshatched area above it of height I_p designated "Investment for Prebuilt Facility." The life of the prebuilt facility commences with the base investment since it is an integral part of initial construction. It continues for the total life, k, of the building, but the facility is "unused" during waiting period, b, before extra space is needed. It is in service thereafter during use period, h.

The cost of deferring, that is, the cost of later construction to modify and extend the original building is the area in Fig. 1 of height I_d designated "Investment for Strengthened Facility." The deferred facility commences its life after b years. Because it probably will be useful only in association with the original building, its life is abbreviated to h years.

From this investment pattern one can visualize that prebuilding is warranted if all the extra costs associated with it during the waiting period of b years are less than the extra costs associated with

deferred construction during the h year use period.

The annual cost increase due to prebuilding is:

$$C_p = \rho_p I_p + \Delta O_p \quad (1)$$

Similarly the annual cost increase incurred when facilities are expanded later is:

$$C_d = \rho_d I_d + \Delta O_d \quad (2)$$

Where C = total annual costs
ρ = fixed charge rate on investment
I = investment
ΔO = differential operating charges
p = prebuilt
d = deferred

The operating term ΔO_p is defined as the difference in cost effected by serving original needs with a facility designed for future needs. Thus, it lasts only through the waiting period b and is zero thereafter. Similarly ΔO_d is zero until the waiting period ends and has a value equal to the difference in cost of the deferred facility compared with the prebuilt facility thereafter.

Equations (1) and (2) may be brought to a common base for comparison and expressed as summations by applying appropriate annuity and present worth factors. The present worth of total excess cost of prebuilding equals:

$$\sum_{o}^{k} P_{1,2,k}\, C_p = A_k\, \rho_d I_p + A_b \Delta O_p \quad (3)$$

In similar manner, the present worth of total excess cost of deferring equals:

$$P_b \sum_{b}^{k} P_{1,2,h}\, C_d = P_b (A_h \rho_d I_d + A_h \Delta O_d) \quad (4)$$

In these equations, the additional terms are:

$P_{1,2,n}$ = Present worth of \$1 payable at the end of 1, 2, n years with interest at rate r
$A_{b,h,k}$ = Present worth of an annuity of \$1 per year for b, h, k years with interest at rate r
r = Component for interest or return on money included in the total fixed charge rate.

These equations show the economic criterion for prebuilding. If the present worth of the accumulated excess annual costs given by equation (3) is less than the present worth of the accumulated excess annual costs for deferring given by equation (4), initial construction should provide for future needs. If the reverse is true, and the costs for deferring are less, initial construction should be limited to immediate needs only.

The break-even point where prebuilt and deferred programs are equal in cost is found by equating equation (3) with equation (4). It may then be shown that:

$$\frac{I_p}{I_d} = \frac{P_b A_h \rho_d + P_b A_h \dfrac{\Delta O_d}{I_d}}{A_k \rho_p + A_b \dfrac{\Delta O_p}{I_p}} \quad (5)$$

This equation establishes the relation between the prebuilt investment I_p and the deferred investment I_d for equal cost.

Oftentimes operating cost differentials are not significant and may be neglected. Then investment differentials alone control the choice of alternative plans. In the manufacturing building used for illustration, this likely would be so if the extra space remained idle but would not be so if it could be rented, for example. Where operating cost differences are negligible, the break-even point occurs when:

$$\frac{I_p}{I_d} = \frac{P_b A_h \rho_d}{A_k \rho_p} \quad (6)$$

This expression is not tedious to evaluate, but an approximation, which has an even simpler form, may be worth while for quick preliminary work. It can be shown that the value of the ratio I_p/I_d will always lie between P_b as a maximum and $P_b A_h/A_k$ as a minimum. Thus, the upper and lower limits to equation (6) can be determined by knowing only the rate of return r, the waiting period b before the future need is expected, and the total life k of the initial construction. To solve equation (6) exactly, it is necessary to know in addition the values for total fixed charges ρ_p and ρ_d.

Fixed Charge Rate

A word may be said about the fixed charge rate ρ. It usually includes the following items:

¶ Expense rate for local taxes, insurance, that part of maintenance that is proportional to investment, etc.

¶ Required return on investment to meet federal and state income taxes.

¶ Rate of return on invested funds for interest and dividends.

¶ Depreciation rate, sinking fund basis, corresponding to the useful life of the facility. For prebuilt facilities useful life would be the normal period of k years. For deferred facilities depreciation would be accelerated and annual accruals increased to retire the equipment in h years.

By this definition:

$$\rho = (e + i + r + d) \quad (7)$$

where each term corresponds to the four items just

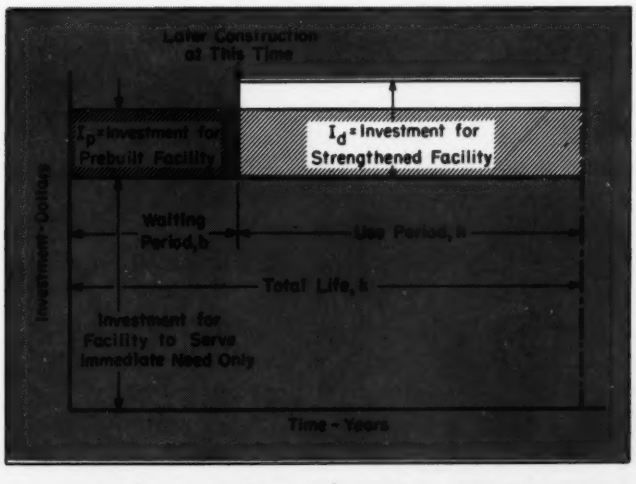

Later Construction at This Time
I_p = Investment for Prebuilt Facility
I_d = Investment for Strengthened Facility
Investment - Dollars
Waiting Period, b
Use Period, h
Total Life, k
Investment for Facility to Serve Immediate Need Only
Time - Years

FIG. 1—GRAPHICAL PRESENTATION OF THE PATTERN OF INVESTMENT FOR PREBUILT AND DEFERRED FACILITIES.

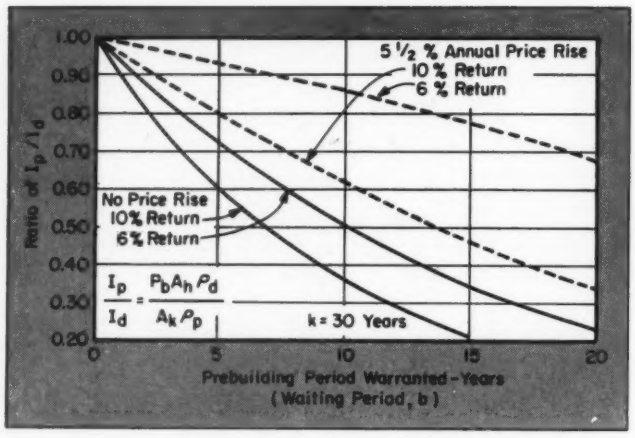


FIG. 2—PERIOD FOR WHICH PREBUILDING IS WARRANTED.

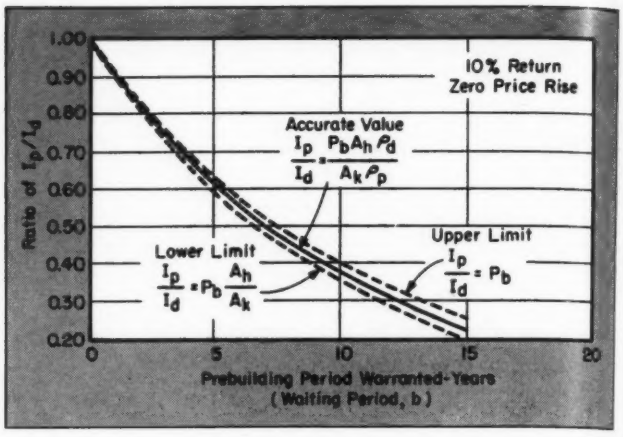


FIG. 3—LIMITS FOR THE PREBUILDING TIME WARRANTED.

enumerated. The total fixed charge rate is the same for prebuilt and deferred facilities except for the depreciation component.

A Question of Time

Obviously the lower the cost of prebuilt facilities in relation to their deferred cost, the longer one can afford to carry them in anticipation of future needs. Two solutions of equation (6), shown in Fig. 2, illustrate this readily. The solid curves show the relationship of I_p to I_d at the break-even point as a function of the length of waiting period b. It will be observed that as I_p becomes small in relation to I_d, the economic waiting period lengthens. These curves have been computed using a total life k of 30 years. Numerical values are shown in Table 1. Two rates of return on invested funds have been used. The lower, 6 percent, is typical of public utility experience while the upper, 10 percent, is more representative of industrial concerns. The value for return affects the income tax requirement. It thus has a compound influence on total fixed charge requirements. Reflecting also the other factors appearing in equation (7), values of 16.08 percent and 26.27 percent for total fixed charges have been used corresponding to 6 percent and 10 percent net return, respectively.

The area lying above the curves defines the conditions unfavorable to prebuilding, for in this area the ratio I_p/I_d for any given waiting period b is greater than at the break-even point. That is to say, the cost of prebuilding is greater (relative to the cost of constructing the same facilities later) than can be

TABLE 1—COMPUTATIONS FOR ECONOMIC PREBUILDING RATIO I_p/I_d

Waiting Period b	Use Period h	A_h	A_k	P_b	$\frac{P_b A_h}{A_k}$	$\frac{\rho_d}{\rho_p}$	$\frac{P_b A_h \rho_d}{A_k \rho_p}$	$\frac{P_b A_h \rho_d}{A_k \rho_p}(1 + 0.055)^b$
				6% Return				
1	29	13.59	13.76	0.94	0.93	1.01	0.94	0.99
2	28	13.41	13.76	0.89	0.87	1.01	0.88	0.98
3	27	13.21	13.76	0.84	0.81	1.02	0.82	0.96
4	26	13.00	13.76	0.79	0.75	1.03	0.77	0.95
5	25	12.78	13.76	0.75	0.69	1.03	0.72	0.94
10	20	11.47	13.76	0.56	0.46	1.09	0.51	0.87
15	15	9.71	13.76	0.42	0.29	1.19	0.35	0.78
20	10	7.36	13.76	0.31	0.17	1.39	0.23	0.68
				10% Return				
1	29	9.37	9.43	0.91	0.90	1.00	0.91	0.96
2	28	9.31	9.43	0.83	0.82	1.01	0.82	0.91
3	27	9.24	9.43	0.75	0.74	1.01	0.74	0.87
4	26	9.16	9.43	0.68	0.66	1.01	0.67	0.83
5	25	9.08	9.43	0.62	0.60	1.02	0.61	0.79
10	20	8.51	9.43	0.39	0.35	1.04	0.36	0.62
15	15	7.61	9.43	0.24	0.19	1.10	0.21	0.47
20	10	6.14	9.43	0.15	0.10	1.22	0.12	0.34

Total life = 30 years

TABLE 2—RISE IN PRICE LEVEL

	Index			Compound Rate
	July 1935	July 1955	Ratio	of Increase
Reinforced Concrete Building Construction	182	542	2.98	5.6%
Brick Building Construction	184	513	2.79	5.3%
Fabricated Steel	172	563	3.27	6.1%
Electric Distribution Systems	170	434	2.55	4.8%
Construction Labor	198	509	2.57	4.8%

warranted economically. Correspondingly, the area below the curve defines conditions under which prebuilding is warranted, for here the cost of prebuilding is below the value at the break-even point.

Example

Suppose, for the building mentioned previously, the added 50 percent floor area could be constructed for only 30 percent increase in base cost. Assume also that, if deferred, it would cost 60 percent of base cost. Then the ratio I_p/I_d would be 0.30/0.60 or 0.5, and Fig. 2 shows that if money was worth 10 percent and the waiting period was 7 years prebuilding and deferring would be of equal cost. Should the future need be expected in less than 7 years, say 5 years, it would be decidedly advantageous from the long-range viewpoint to anticipate it by prebuilding.

The possibility of a quick approximate determination of the economic break-even point has been mentioned. Fig. 3 repeats the solid line curve of Fig. 2 for 10 percent return. It is the accurate solution of equation (6). The dashed curves above and below it define the area within which this accurate solution could lie. The maximum value, P_b, is readily found from standard discount tables, while the minimum value, $P_b A_h/A_k$ includes two additional factors available in standard annuity tables. Thus, in Fig. 3 it can be seen that to justify economically a 10 year prebuilding time for equipment having a 30 year life, it is necessary that the prebuilding cost not exceed 35 to 40 percent of the deferred cost. The solid line shows the accurate value to be 38 percent for the total fixed charge rate that is assumed for this illustration. Looking at the problem from another angle, if estimated prebuilding cost is 50 percent of deferred cost, a waiting period ranging up to 6½ to 7½ years would be warranted. Again, the solid line gives the accurate value, which is 7 years. In these illustrations, the approximate solutions are certainly quite acceptable for quick preliminary work to be done by the consulting engineer.

Effect of Price Rise

So far, the effect of changes in price level with time has not been considered. Our persistent national upward trend of costs has an important effect on prebuilding economics which ought not to be overlooked. If it were known that future price levels would be substantially above present levels, it would be worth while to spend more for prebuilt capacity than if prices were expected to remain static.

In the 20 year period since 1935, price rises have occurred in some major areas of construction as shown in Table 2. The increases are not all the same, nor have they taken place uniformly with time, but it may be said that since 1935, the annual rise in general construction cost has averaged about 5½ percent. Construction deferred for five years stands a chance then, if this trend continues, of costing 31 percent more than its estimated cost today, this being the increase for five years taken at 5½ percent compounded annually.

Price Rise Factor

Since an economic balance as determined by equations (5) or (6) is valid only for the actual costs incurred, I_d should be the cost at the price level prevailing when deferred construction takes place. In making cost estimates, I_d usually is measured at the same price level as I_p, the immediate construction. If ϵ is the annual long term rise in price level, it develops that the prebuilding cost that is warranted economically in a period of rising prices is $(1 + \epsilon)^b$ times as great as that warranted in a period of static prices. That is, if $(I_d)_o$ is the cost of deferred construction as estimated at the current price level, the break-even point is determined when:

$$\frac{I_p}{(I_d)_o} = (1 + \epsilon)^b \frac{P_b A_h \rho_d}{A_k \rho_p} \qquad (8)$$

Untempered application of this formula is not recommended. Simple price rise is not the only factor to consider. Advance of the art, for example, is an important item because it influences and determines the real cost of deferred facilities.

The effect of 5½ percent simple annual price rise is illustrated in Fig. 2 by the dashed lines. Referring again to the building for which the ratio I_p/I_d was 0.5—or to be more exact the ratio $I_p/(I_d)_o$—it may be seen that prebuilding and deferring are of equal cost for a waiting period in excess of 13 years. This is 6 years longer than the 7 year waiting period found if prices do not rise at all. It is evident from this that

price rise, even if its impact is lessened by other factors, can have an important influence on planning.

Operating Cost Differences

It is often found, when comparing alternative plans, that operating cost differences as well as investment differences must be taken into account. In fact, savings in labor or maintenance or perhaps fuel or other costs during the prebuilding period may support a greater prebuilding cost than would be warranted otherwise. It should be observed that the problem of accounting for operating differences in this instance is not the familiar one of determining the optimum size of an installation where provision for future growth is not a factor. Under those conditions operating differences prevail for the full life of the facility, and the planner need only select that facility which affords the lowest combination of annual operating costs plus fixed charge burden in the first year.

Operating differentials in prebuilding problems, on the other hand, do not last indefinitely. They tend to show a marked change at the end of the b year waiting period and may disappear or even reverse thereafter. If the operating difference is more or less uniform, but of limited life, it can be converted to an equivalent uniform annual value covering the same life span as the facility with which it is associated. For an operating differential lasting b years, the multiplying factor to apply to the actual average value would be A_b/A_k. The equivalent uniform annual value so obtained then would be divided by the fixed charge rate to give an "investment," I′, to be combined with the actual investment I_p or I_d as the case might be. The resulting figure will have annual fixed charges alone equal to fixed charges and operating differential for the actual investment. It can be used with the curves of Fig. 2 to choose between prebuilding or deferring just as though it were an actual capital investment with no annual cost burden other than fixed charges.

Year-By-Year Solution

The planner often is not treated so kindly by operating features of the alternatives he considers. Growth occurs in many small steps and not all at once; hence, annual operating charges constantly shift. Then too, multiple increases in facilities may be desired. A different approach becomes useful. Total annual investment and operating charges are determined for each year for each development plan and multiplied by the suitable present worth factor P_n to refer them to some given year, usually the date of initial construction. Such a method enables the planner to find directly the present worth of the excess of costs of one plan compared with the others.

This is often more informative than a knowledge of the break-even point. Basically the same relationships apply, for the annuity factors A that appear in the equations are only the summation of present worth factors for the corresponding period of time. Equations (3) and (4) are useful for a year-by-year solution. Care must be exercised to carry the comparison of plans far enough into the future to reflect all important cost differences and to end it with plans as nearly equal in service characteristics as possible.

A good example of a planning problem suited to a year-by-year solution would be the electric power system in a new industrial plant, say a steel mill. An estimate of total immediate load would surely be available, and a forecast of probable future load growth could be developed. Based on his experience, the planner would prepare alternative designs of electrical systems to serve these loads, providing reserve margin for future growth in the degree his judgment would suggest. His selection would cover the range of voltages, feeder arrangement, substation location, and circuit arrangement appropriate to his problem. By their inherent design they would contain differing margins of reserve for future growth.

Using his load forecast as a guide he would estimate the timing and cost of future substation or line additions. He then would determine as accurately as he was able the annual costs for operation, maintenance, electrical losses, and any other important similar charges, adding them to the annual fixed charges on investment. If feasible he also might estimate probability of outage and probable resultant cost in loss of production or in harm to equipment.

Totaling these costs year by year for a period of ten, or perhaps more, years into the future and applying present worth factors would reveal which plan enjoyed the most favorable long-term cost. The planner then might study further to determine whether the long range cost of this plan would be even lower if more prebuilt capacity were provided within the initial construction.

Less Clairvoyance Needed

Assuredly not all the factors that might bear on the problem of prebuilding can be reduced to terms of annual cost, nor can all future contingencies be foreseen with clarity, if at all. Nevertheless it is better to consider all the known elements of cost in this manner than to leave them solely to intuitive judgment. By thus including all the known or forecast future elements of cost, by using the best possible cost estimates, and by converting future costs to present values, sound mechanics in establishing a logical conclusion from a given set of assumptions is substituted for clairvoyance.

Good judgment, both engineering and management judgment, is still required. In the final analysis the plan of lowest cost as determined by this procedure may not be the one selected. But in reaching the final selection, judgment is obliged to work only within a greatly narrowed field of uncertainty. The chances of selecting that plan containing the optimum of prebuilt capacity is greatly improved. ▲▲

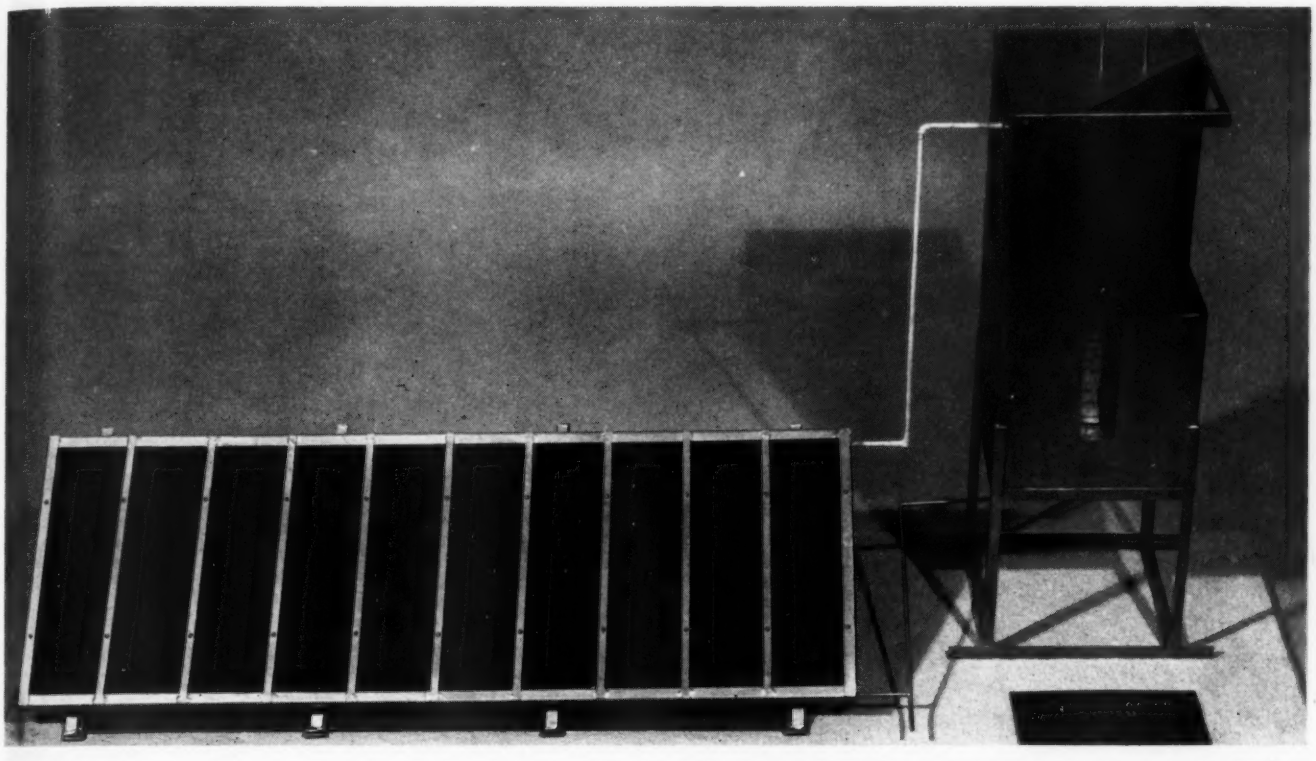


FIG. 1 — MODEL OF A SOLAR HOT WATER SYSTEM OF THE TYPE USED IN SOUTHEASTERN UNITED STATES.

Practical Applications of Solar Energy

E. A. FARBER and J. C. REED
College of Engineering, University of Florida

STANDARD SOURCES of energy are being depleted at a very rapid rate. This was brought out and stressed at the World Symposium on Applied Solar Energy, a world-wide meeting of scientists, held at Phoenix, Arizona, in the fall of last year. The figures given out at that meeting showed that if we continue using our fossil fuels at the present rate we have only 2000 years of coal, 23 years of natural gas, and 10 years of oil.

These facts have prompted many scientists to attempt an all-out search for new sources of energy upon which future progress can be built.

Atomic energy from fission, although in its infancy as a usable source of power, has entered the picture in time to provide a new and valuable source of energy. It is limited, however, both by uranium ore supply and by the inherent hazards of radiation. There are other sources of energy that are virtually untapped but that seem to have unlimited possibilities. Some of these are the gravitational field of the planetary and stellar systems, the electromagnetic field of the earth and the stars, the energy radiated to us from the sun, and atomic fusion (hydrogen). Scientists are working on the utilization of some of these potential energy sources.

The greatest promise at present seems to lie in the field of solar energy. Since almost $12 billion have been spent on the development of atomic energy and practically nothing on the development of solar energy, it is surprising how much has been accomplished in the utilization of the sun's energy.

Solar Energy

The energy coming to us from the sun as sunshine is actually atomic energy produced on the sun, and radiated to us through space. Only a very small fraction of the total amount produced on the sun reaches the earth and is available to us, yet the amount of energy available from this source is tremendous. For instance, the average modern house receives on its roof more than 100 times the energy fed to it by electric lines. Each square yard of the earth's surface receives solar energy at the average rate of one horsepower per hour.

The common definition of efficiency has little meaning in the field of solar energy since we do not have to pay for this energy as we do for coal,

FIG. 2 — HERE A SERIES OF MIRRORS ARE USED TO CONCENTRATE THE HEAT OF THE SUN AND SET WOOD ON FIRE.

oil, or gas. However, the fraction of the available solar energy that has to be converted to compete with present-day practices takes on meaning. For instance, in Egypt camels are used in treadmills to irrigate the land. If an engine were to convert 0.8 percent of the energy from the sun falling upon the circle in which the camel walks, the camel could be replaced. In addition, the three acres that are used to raise food for the camel then could be used for other purposes.

Historical Uses of Solar Energy

A number of instances can be found throughout history when the energy from the sun was put to use. The Greeks, about 300 BC, dispersed a Roman fleet attacking their harbors by using mirrors to concentrate the sun's rays upon the ships, thereby setting them afire.

In 1695, Italian scientists were able for the first time to burn a diamond, which up to that time was considered incombustible. They generated the necessary heat by concentrating the sun's rays with a system of lenses.

In the latter part of the 19th Century a large solar still was built in Chile. It produced fresh water through distillation, using the sun's energy for the evaporation.

About the turn of the 20th Century a number of

FIG. 3 — SOLAR HEATERS BEING TESTED AT UNIV. OF FLA.

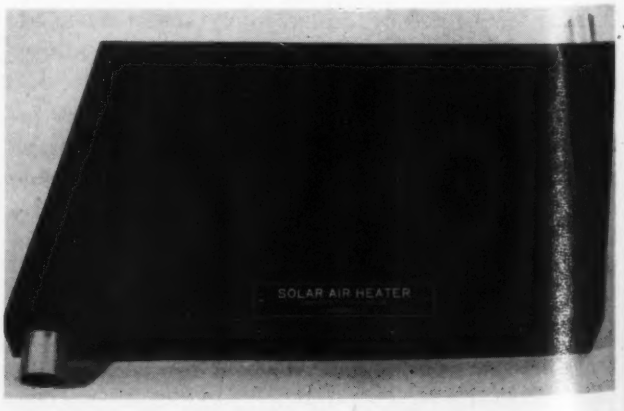


FIG. 4 — SOLAR AIR HEATER DEVELOPED AT UNIV. OF FLA.

attempts were made to produce power by means of solar energy, and a number of large concentrating cones and parabolic troughs were built which supplied steam to engines up to 100 hp in size. In France a printing press was operated by means of solar energy.

Present Uses of Solar Energy

Since the early attempts at harnessing the energy coming from the sun, tremendous progress has been made in those parts of the world that lack conventional sources of energy. Most inhabited parts on the earth suffering these deficiencies are generously supplied with sunshine.

The greatest progress has been made in the field of solar water heating, and many installations have been built and have operated satisfactorily for many years. These can be found in large number in the Southern United States, Russia, Israel, Egypt, and Japan.

A typical solar hot water system used in the Southeastern United States is illustrated (Fig. 1). It makes use of an absorber, which is a metal plate with copper tubes firmly attached and painted with a high absorbing paint. This absorber is placed in a box which is insulated underneath the absorber and has glass over it. With this arrangement the losses are considerably reduced and the conversion efficiency increased. The sun's energy is absorbed by the metal plate and then conducted as heat to the water flowing in the tubes. The hot water is stored in a tank until needed. The tank is insulated to keep the water hot as long as possible.

Some use is made of the sun's energy to produce extremely high temperatures, essentially by superimposing the sunshine. Two mirrors, reflecting sun's rays upon the same area, will produce twice the normal sunshine intensity; three mirrors, three times as much. Large concentrating panels have been built having more than 1400 mirrors. Fig. 2 shows a few small panels of such design. Only about 18 concentrations are needed to set wood on fire. Several large installations of similar design are used in Europe to bake ceramic materials on a commercial basis.

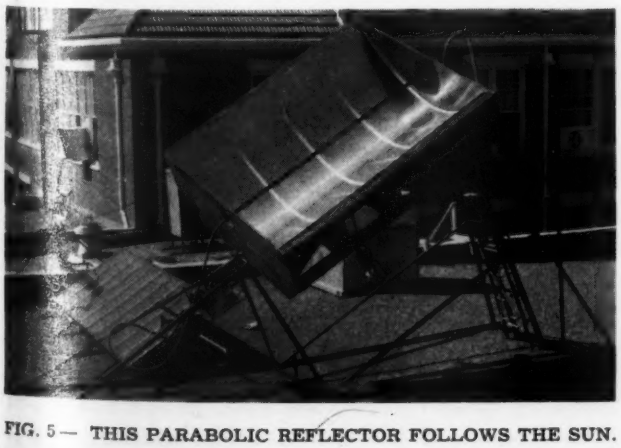


FIG. 5 — THIS PARABOLIC REFLECTOR FOLLOWS THE SUN.

FIG. 6 — THIS ABSORBER DOES NOT NEED TO BE ROTATED.

Less than two years ago the first reasonably efficient conversion device, designed to change the sun's energy directly into electrical energy, was built — the "solar battery" of the Bell Laboratories. Such batteries are now used in Georgia to operate rural telephone lines. The energy not used during the day is fed into storage cells which supply the energy during the night and in bad weather.

Future Uses of Solar Energy

Experiments currently are being carried on all over the world to find and develop all possible uses of solar energy. Many applications have been found and now are being perfected so that they can become competitive with the present energy conversion and utilization methods.

Solar Water Heating. New types of solar water heating systems are being designed to give better performance from cheaper and better equipment. A number of different experimental solar absorber elements are shown in Fig. 3. Experimentation also is being carried on with dual circulation systems which cannot be damaged by freezing weather and which operate under atmospheric pressure in the primary or energy-absorbing circuit. The liquid can be circulated either by free convection, or it can be forced by a pump. Some installations in Israel have a solar energy pump for this purpose.

Solar Air Heating. A few houses have been provided with solar air heaters on an experimental basis. Such air heaters consist of a metal-absorbing plate or plates which become hot, and the air circulating between or over them picks up this heat.

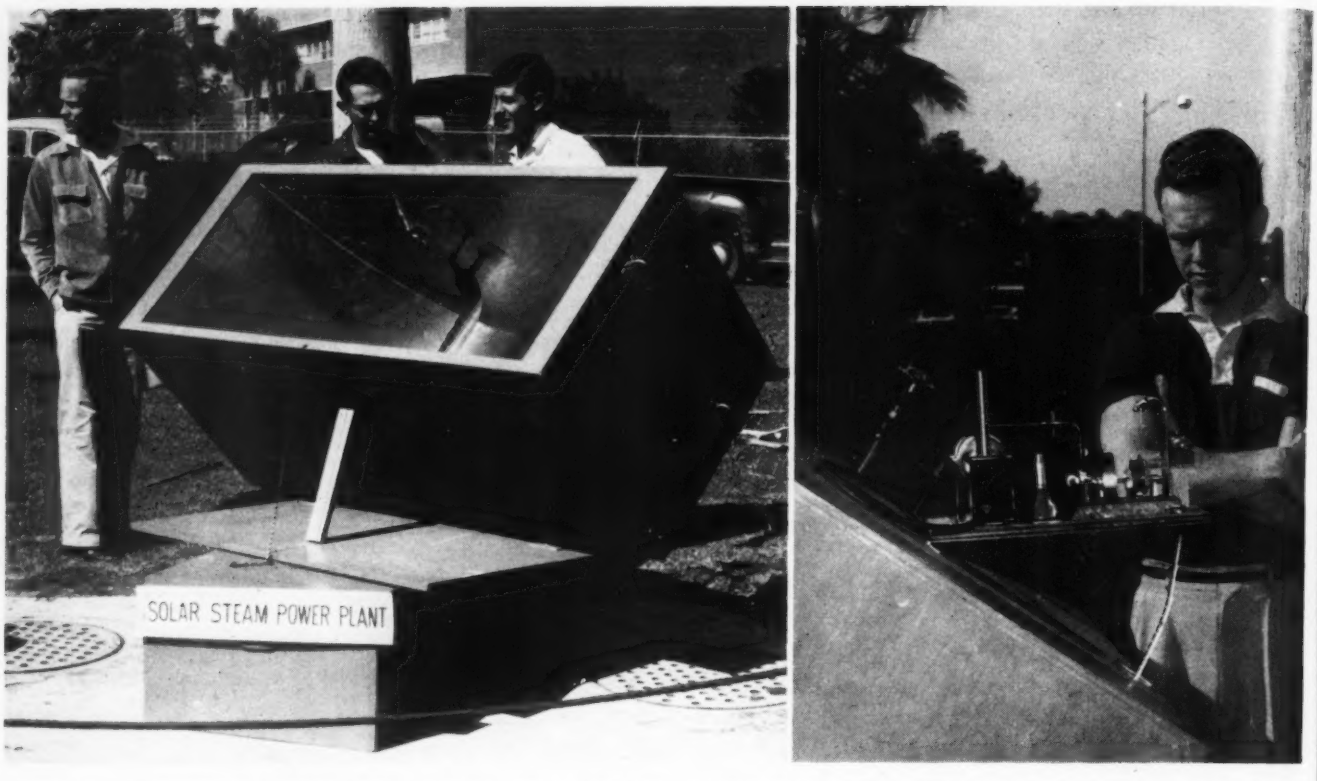


FIG. 7 — A WORKING MODEL OF A SOLAR STEAM PLANT. PARABOLIC REFLECTOR HAS PIPE BOILER AT FOCUS.

Again free or forced circulation can be used. Fig. 4 shows an air heater.

Heat storage for times when the sun does not shine, presents one of the greatest problems of these installations, and as yet it has not been solved satisfactorily. Rock beds, water pools, and chemical salts have been tried.

Solar Power. Solar absorbers are limited to heating since they are not able to produce the temperatures needed for power generation. The sun's energy has to be concentrated by means of mirrors or mirror surfaces for power generation. Fig. 5 shows a parabolic reflector which intercepts a considerable amount of sunshine and then concentrates this energy upon a pipe at its focus. In this manner it is easy to generate high temperatures, obtaining the desired values by varying the degree of concentration. Often glass is put around the tube or over the whole apparatus to reduce heat losses to the air. This kind of absorber gives the high temperature needed, but it is rather complicated and expensive since it has to turn to follow the sun all day long.

For this reason another type, the high temperature absorber, has been developed. It has the advantages of both flat plate and parabolic absorbers. Parabolic troughs are placed horizontally, running east-west, and thus collecting the sun's energy all day, concentrating it upon the pipe at the focus. Rotation is not necessary, and the design is much more convenient and inexpensive. A certain amount of energy is lost early in the morning and late in the afternoon when some of the reflected rays do not hit the pipe. This shortcoming is overshadowed heavily by the advantages (see Fig. 6).

A working model of a solar steam power plant is shown in Fig. 7. The sun's energy is collected by a parabolic reflector and concentrated on a pipe-boiler where the steam is generated. This steam then goes to a steam engine which drives an electric generator. A light bulb is operated on the generated electrical current and the excess is fed to storage batteries, which supply electric current when the sun does not shine. A standby steam generator also is provided to supply steam for the engine.

Solar Refrigeration. Solar refrigeration is possible but again high temperatures are needed. Absorbed energy can drive a compressor or operate the generator of an absorption system. It is important to note that refrigeration, cooling, and air conditioning are needed most when the sun shines hottest — concurrently with the time the greatest amount of energy is available. This makes solar energy an ideal source of energy for refrigeration equipment.

Solar Cooking and Baking. The temperatures needed for cooking and baking are such that if they are done with solar energy only relatively small amounts of concentration are required. This allows the fabrication of cheap reflectors which only approximate the ideal shape. Many different designs have been developed, including collapsible ones, very similar to umbrellas, painted with a reflecting paint and provided with a support for a pot or pan. Many of these cookers are used in India. A solar oven consists of a box into which the sunshine is

reflected. This can be done by separate panels or by flaps attached to the box. A solar oven and a solar cooker are shown in Fig. 8. More complicated designs providing for heat storage can be made.

Solar Distillation and Irrigation. The need for fresh water is great in many areas. Wastelands frequently have fertile soil but lack water. Irrigation with ground water often is impossible since salts that are dissolved in this water will soon saturate the soil to the point that nothing will grow. In Australia, for example, much land has been ruined in this manner.

Large saline water distillation systems now are being built experimentally, many of them sponsored by the U. S. Department of Interior, in an attempt to find a cheap method for obtaining fresh water. The sun does this naturally on a large scale by evaporating the water from lakes and oceans and redepositing it as rain, but unfortunately not always where it is most needed.

It might be noted that the need for fresh water is greatest when the sun shines hottest thus producing a convenient combination. A solar still design is shown in Fig. 9. Experimental solar pumps that are able to pump the water where it is needed also have been designed and tested. Such pumps are used in Italy, on a small scale, for irrigation.

Solar Converters and Batteries. Since so much of today's civilization is built upon the use of electricity, the direct conversion of sunlight into inexpensive electric current is a logical goal. Progress has been made to the extent that solar batteries

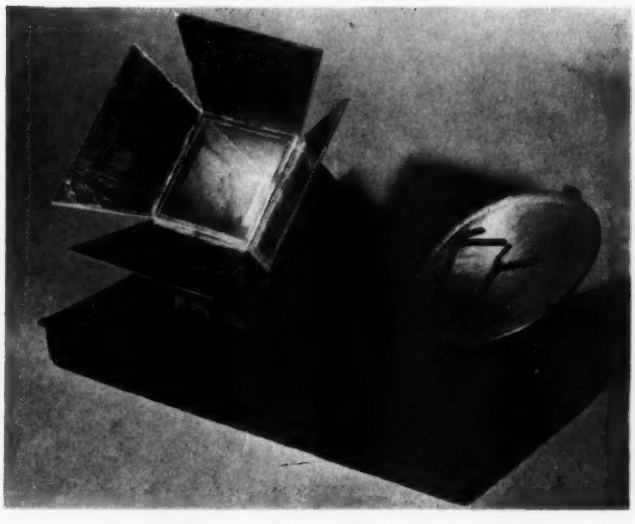
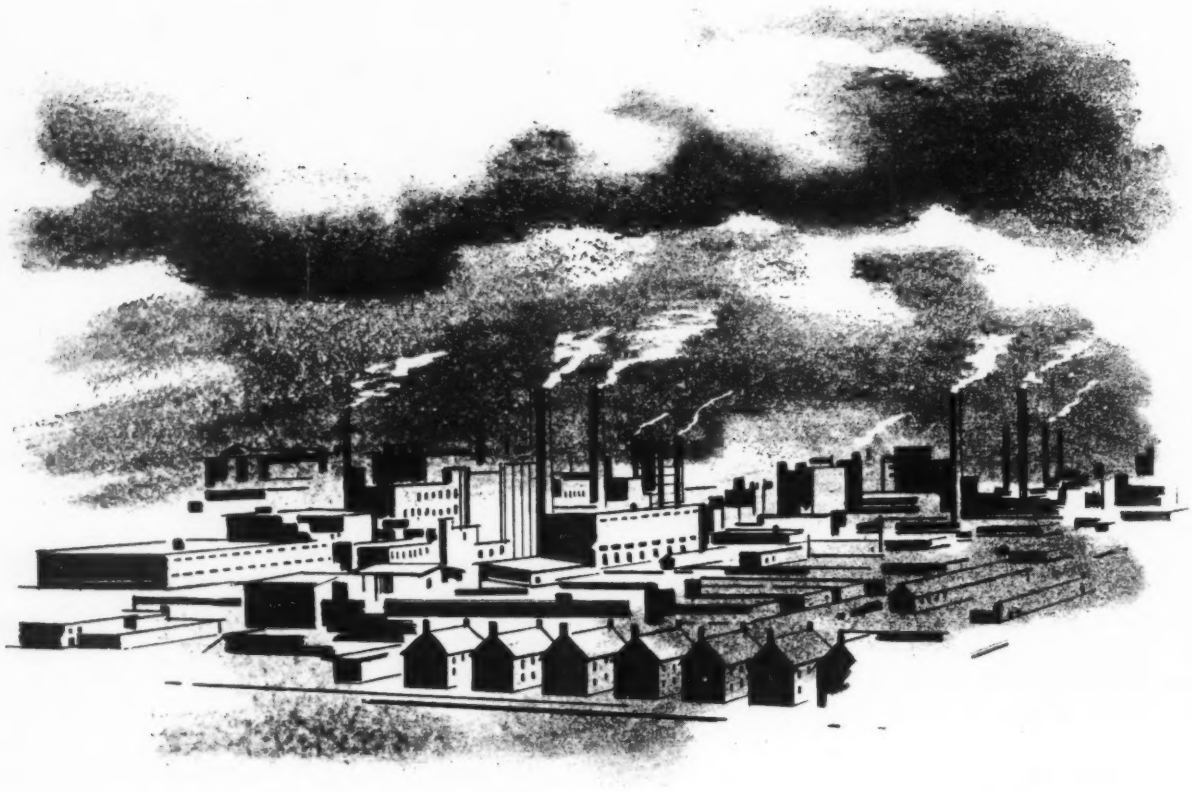


FIG. 8— SIMPLE SOLAR OVEN (LEFT) AND SOLAR COOKER.

are used, but they are very expensive to construct and other cheaper ways of producing this energy are to be desired. No doubt, better and cheaper solar batteries will be developed in the near future.

Photochemistry and Photosynthesis. Research in the use of photosynthesis is still in its most elementary state. Although many scientists have concentrated their effort upon this field, they have not yet been able to imitate the function of plants in using solar energy to convert carbon dioxide and water into sugar. If this is ever accomplished it may well become more important than all the other methods of utilizing solar energy. ▲▲

FIG. 9 — EXPERIMENTAL SOLAR STILL. STILLS OF THIS TYPE PLUS SOLAR PUMPS ARE USED FOR IRRIGATION.



Air Pollution - - Problem For Consultants

WILLIAM G. CHRISTY, Consulting Engineer

William G. Christy is probably the outstanding authority on air pollution. Since 1926, when he helped pioneer and acted as Executive Secretary, Citizens' Smoke Abatement League of St. Louis, Christy has organized, administered, and been consulted on air pollution control programs in many parts of the country. An ME graduate of Cornell University, class of 1911, he is well-known in the professional engineering societies. Mr. Christy returned to his private consulting practice after serving as Chairman of the Smoke Control Board, New York City, 1950 to 1952.

CE exclusive

THE HUMAN ELEMENT is important in air pollution control work. It must be stressed at every opportunity. People are prone to be careless, thoughtless, inattentive, or lacking in proper knowledge. An enormous number of excessive emissions of dust, fumes, smoke, and soot could be prevented if every one concerned were alert, attentive, careful, and properly informed and trained. It is on this account that air pollution consciousness is so vital. As in so many activities, education of the public, of the personnel of industries, of property owners, and of local government officials is essential.

Many leaders in our profession advocate engineers taking a more active part in civic and community affairs. Control of air pollution, being highly technical, is one such activity in which engineers should take particular interest. There are many communities with air pollution problems — and not enough is being done about them.

One of the best ways to start an effective program is to organize a Citizens' Committee. Prominent civic leaders should serve on the Committee, and several engineers including consultants ought to be members. The group also should include a public relations representative and an advertising executive.

The principal function of such a group is to conduct an educational program. The public should know that much air pollution is preventable and that most of it can be eliminated by a well organized and sustained program. The Committee should have a Speakers Bureau, with speakers available for meetings of civic clubs, professional and business groups, service clubs, and women's clubs.

Posters and cartoons for use on billboards and in leaflets or bulletins can be made quite helpful. Usu-

ally advertising people can be sold on the idea of contributing their services, and engineers can work with them to see that the story they sell to the public is technically sound.

Engineering Evidence

Consulting engineers can play a vital part in such a project. They are in a position to supply evidence and convincing arguments that "it can be done." They can furnish concrete examples of fuel savings by smoke elimination. Usually consultants can be found who can give first hand accounts of eliminating pollution nuisances. This is a worthy public service for consulting engineers.

The consulting engineer also can help in framing logical and enforceable legislation. It is only a question of time until almost every area in this country will have some kind of air pollution legislation. Almost every day, agitation about air pollution is started in some community. However, it is basically the job of industry to avoid air pollution, and here, again, the consulting engineer is the key man, for he can serve his clients by showing them how to save money and reduce the air pollution problem.

Industry Action

Every large industry that contributes at all to air pollution should have its own air pollution control department. Small plants ought to have an air pollution committee. Such committees are usually made up of plant supervisors. It is desirable to designate some employees as air pollution inspectors. The object is to have the industry police its own plants for air pollution emissions.

It is an excellent idea for an industry to have a consultant make an occasional engineering survey of its plants, and a consultant can also advise on special problems. The purpose of a survey is to ascertain and analyze the actual and potential air pollution problems. Any such survey should include analyses of effluents. For example, if there is a potential source of dust, such as a pulverized coal fired furnace, cement kiln, asphalt plant, cupola, or open hearth, dust concentration tests should be made. Such information would be appreciated by any governmental engineer or inspector.

As the human element is so important, an educational program is desirable. Many concerns have regular air pollution meeetings of all supervisors and employees who have anything to do with scrap and waste disposal, raw materials, fuel, operation, and maintenance. At such meetings, the plant's or the industry's air pollution problems can be discussed. Occasionally the firm's consulting engineer might be invited as a guest speaker. A number of concerns report that such educational meetings on company time are quite worth-while.

Another activity which helps is the use of posters. For many years, most industries have carried out active and effective safety programs. Posters are displayed periodically and safety meetings are held at regular intervals. Why not have active air pollution control programs along similar lines?

Legislation

More than 250 municipalities in this country have some sort of air pollution ordinances although many are overlooked or only loosely enforced. There are at least five counties which have county-wide legislation. As air pollution knows no political boundary lines, there are many places where control on an area, county, or regional basis seems sensible. After Acts of the U. S. Congress and the Canadian Parliament, an International Air Pollution Commission was organized in the Detroit-Windsor area a few years ago. After suitable legislative authorization and appropriation, the Interstate Sanitation Commission now is undertaking a survey of air pollution in the New York City-Northern New Jersey Metropolitan area. The California Legislature recently adopted a bill authorizing an area air pollution control district which will include several counties in the San Francisco Bay area.

Drafting an Ordinance

At present, in many communities that have no air pollution legislation, there is agitation for adoption of an air pollution code or ordinance. Often the municipal attorney is asked to draft an ordinance, but most lawyers have little knowledge of air pollution problems. Making the first draft of such an ordinance is an engineer's job, especially a consulting engineer with some experience in this field. After an engineer makes the first draft of such legislation, then the attorney may put it in proper legal form.

With the trend towards control of air pollution on an area, county, or regional basis, many well intend-

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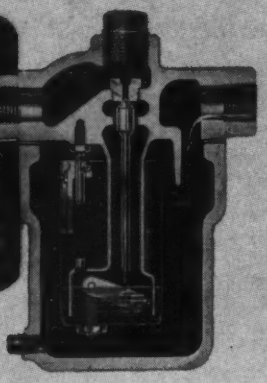

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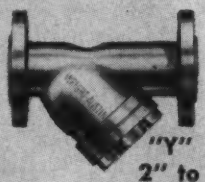

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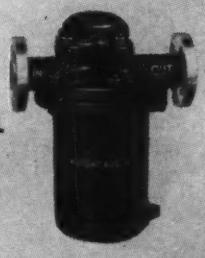

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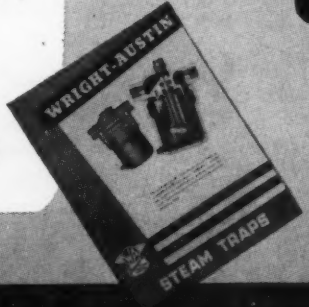

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ed people feel that we should have state control. A few states now have some form of air pollution legislation and others are considering it. It is a fine thing for a state to do research work, as well as make investigations. Another worth-while function of a state is to formulate uniform codes and regulations. But state enforcement is not desirable. State-wide enforcement of air pollution regulations would get very unwieldly in any of our more populous states. It would tend to build up bureaucracy. Strict enforcement throughout a state would be almost hopeless. For really reducing air pollution, enforcement should be on a local basis.

Cooperation

Consulting engineers, management of commercial and industrial enterprises, property owners, building managers, and governmental officials can eliminate much air pollution by working together. The best results in enforcement programs are secured by cooperation of offenders and those charged with responsibility for enforcing air pollution regulations. An offender, who evinces willingness to make changes in order to control air pollution, usually will find local officials ready to give ample time for making contemplated improvements. In speaking of cooperation, we must realize that real cooperation means that any promises should be given in good faith.

Big Project

The public is prone to think of air pollution control in too small terms. Adequate control of air pollution is really a major community housekeeping project. It should be considered in the same manner as keeping roads and streets paved, clean, and in repair, providing an ample supply of pure water, providing an adequate system of sewage and waste disposal, and maintaining a good moral atmosphere. Another requirement is continuity of the work. There should be no let-up in the effort. Too many communities would like to eliminate atmospheric pollution but are not willing to pay the price—in money or in effort. ▲▲

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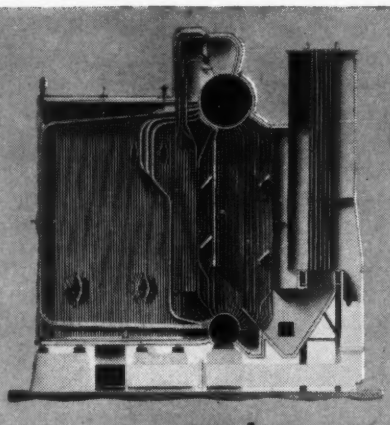

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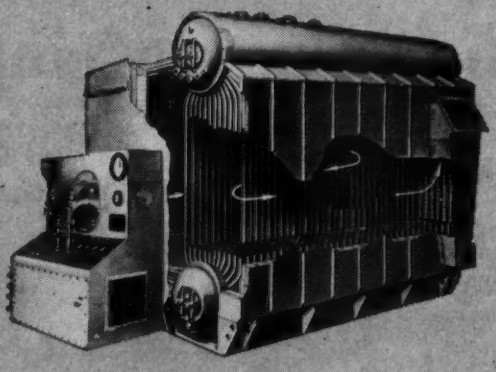

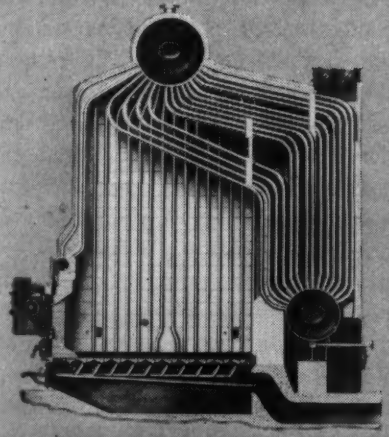

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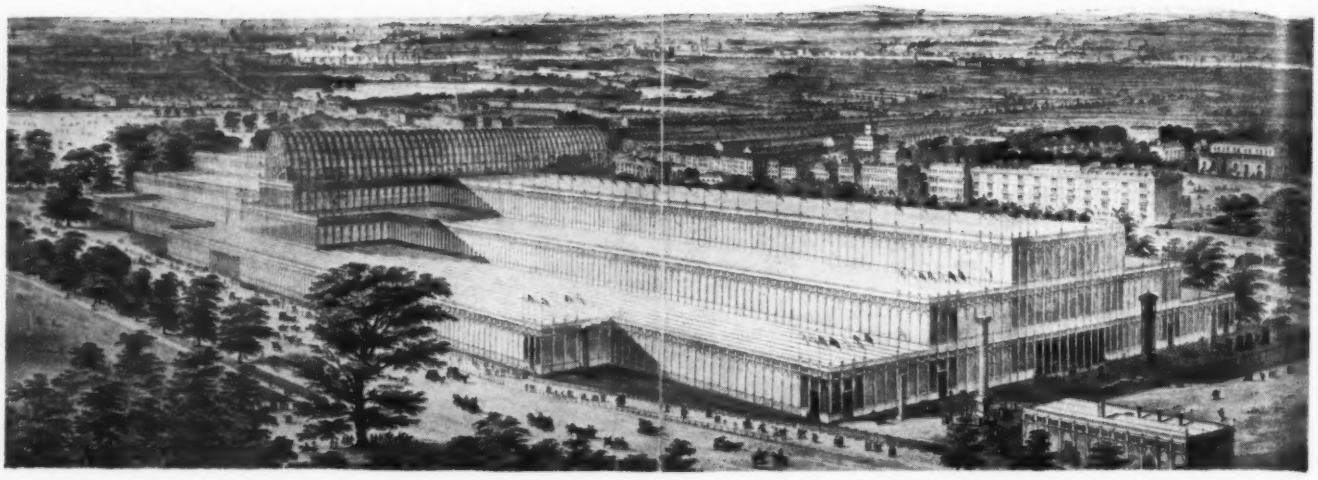


THE GREAT EXHIBITION OF 1851, HELD IN THE CRYSTAL PALACE, IN LONDON, STIMULATED A DISCUSSION OF THE POSITION OF THE ENGINEER IN SOCIETY. SHOULD HE BE A MECHANIC OR BUILDER EDUCATED IN A TRADE SCHOOL OR BY EXPERIENCE—OR SHOULD HE HAVE A UNIVERSITY DEGREE AND ESTABLISH ENGINEERING AS A PROFESSION?

In England, the 19th Century was at Mid-Passage

When Engineering Became a Profession

Dr. THOMAS HUGHES
Washington and Lee University

IT IS NOT UNUSUAL for an engineer, in a pensive moment, to look at his profession and wonder how it came to its present position in the structure of society. Historically, the picture he usually sees of the gradual development of engineering as a profession is far from correct. Engineering, as we know it, is a very recent profession. It can trace its origins to the constructors of the pyramids, to Leonardo da Vinci, or to the builders of the cathedrals only by following the most hazardous and unreliable trails. It was as recent as the middle of the last century that informed circles began to take note of the wide gap between men of pure science and the practical designers and inventors, and recognize that there was a need to bring the theoretical and the practical together—a need that today's engineer attempts to meet in his practice of his profession.

In 1851, England was the undisputed industrial giant among the nations. She had reached this position without questioning the reason for it, assuming perhaps that this superior position was to be expected of England. In 1851, in a way strongly suggesting self-satisfaction, England displayed her industrial, agricultural, and artistic accomplishments, alongside those of other nations, in the Great Exhibition, held at the Crystal Palace, in London.

It was during this Exhibition, however, that the English took stock of themselves, and following this grand display, English scientists and men of learning entered into an important discussion involving self-appraisal. The results of this discussion influenced the relative position of England as an industrial nation, brought about important developments in standardization of materials and methods, and wrote an important chapter in the history of engineering as a profession. A review of this critical discussion should interest the consulting engineer, for it was after that time, rather than in ancient history, that engineering, as a profession, became a major influence on civilization.

In midnineteenth century, at the time of the Great Industrial Exhibition, the ideas of most of the population of England were expressed in the popular publications such as the cheap journals and the *London Illustrated News*. These media expressed wonder and amazement at the nation's industrial capacity and enthusiastically described the marvels of human ingenuity and the machine capabilities resulting from industrialization.

A more sophisticated and informed circle also was interested but not so overawed that critical faculties were stunned. The Great Exhibition provoked comment from many of these better informed critics of the scientific and industrial scene.

William Whewell, an influential teacher and scien-

tist at Cambridge, gave before the learned Society of Arts the inaugural lecture on the results of the Great Exhibition, and this lecture received wide comment and dissemination. It appeared in a number of publications, including *The American Journal of Science and Arts,* and was the source of ideas influencing subsequent lecturers before the Society. Whewell set the tone for reformers critical of the existing relationship between pure science and practical industry in mid-Victorian England.

Following Whelwell's lead the Reverend Robert Willis, who gave one of the lectures before the Society of Arts, found the lack of a closer union between the scientific and practical man regrettable. To him the first object to be pursued by men desirous of improving the state of manufacturers in England was to effect an intimate union between the practical and the scientific—a union that would make engineering professional. He said: "It is no secret that there has always existed an unfortunate boundary wall or separation between practical and scientific men, a mutual distrust or misunderstanding of their relative values, which has deprived them of many great benefits that they might have mutually derived from each other's pursuits. It is true that in many branches of science, as in chemistry, geology, and botany, this barrier has to a great extent been broken through; the practical man has found the benefit of scientific generalizations and the theorist has been compelled to seek the facts upon which his theories are to be based in the mines and manufactories; thus compelling the two classes to work together and learn to understand each other. Still there remains too much of the ancient contempt for 'theory,' and of an overweening and conceited value for 'facts' and 'practice.' "

He believed that practical mechanics suffered most severely by separation from its related science, geometry. The trained geometrician or mathematician did not trouble, or even acquaint himself, with the problems faced in the practical applications of machine makers. Every well-designed machine was a materialization of a number of solutions of geometric problems, but men especially trained to solve these problems did not have a part in the solution.

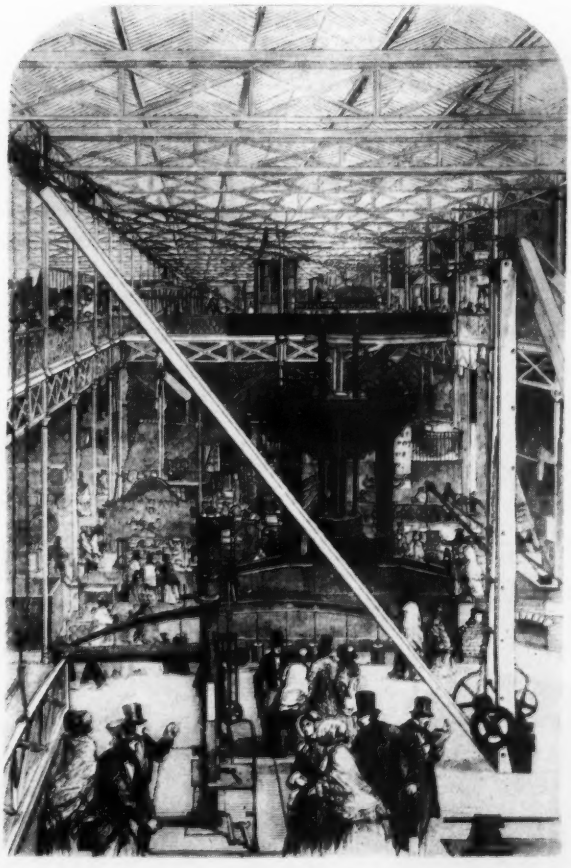
On the other hand, the mechanic or ingenious inventor who designed the machine showed no awareness of unexplored possibilities that could be exploited by a closer union between theory and practice. Many mechanics, according to Willis, prided themselves on the fact that they had received no formal training in geometry—or in any of the other sciences, for that matter.

The absence of available scientific records and treatises further hindered communication between the man of science and the practical man. Captain John Washington called to the attention of the Society of Arts the fact that England had not one original truly scientific treatise on the subject of shipbuilding in her language as of 1851. The earliest English treatise of a scientific character on this subject was published by Mungo Murray, in 1754, and the work of that gentleman was held in so little esteem by his contemporaries that Murray lived and died a shipwright in the Deptford Dockyard.

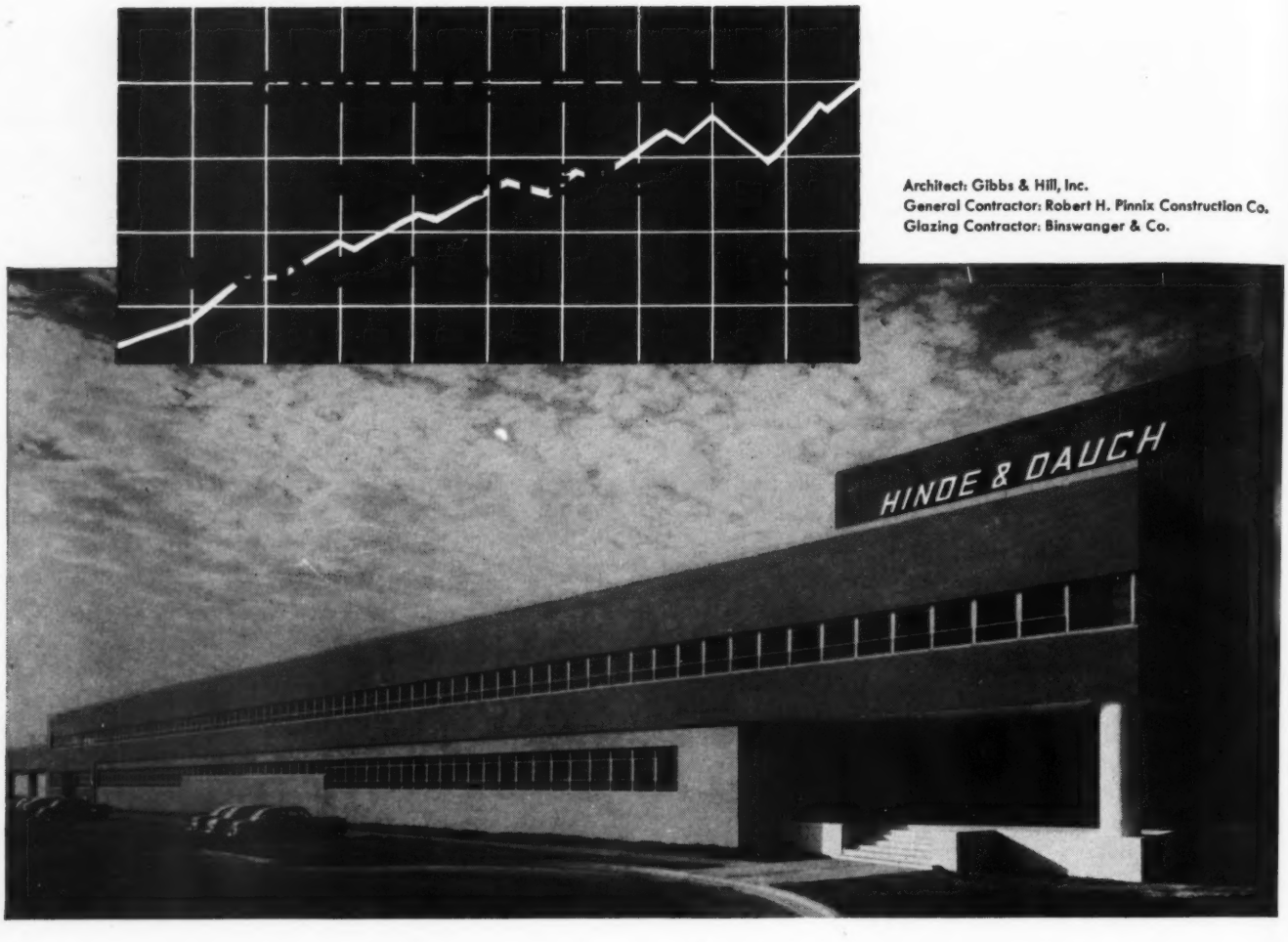
The jury reporting on machinery at the Great Exhibition agreed that a wider dissemination of technical and scientific information was desirable. This failure resulted, for example, in the common fallacious impression among factory mechanics that an engine's work capacity could be increased by changing the direction of its moving parts.

One of the most important steps that could be taken to rationalize industry—to make it scientific—according to Whewell, was an application of the principles of classification. He desired a further and more detailed classification of all the materials, instruments, and productions of human industry. The results of classification would be important. A common language for the manufacturer, the man of science, the artisan, and the merchant could be developed. By facilitating cooperation, the use of a common language would increase quality and production in industry.

Specifically, Whewell hoped to see wires, nails, tubes, and wheels classified and named so that all



IN 1851 ENGLAND LED THE WORLD INDUSTRIALLY. HERE IN THE MACHINERY EXHIBIT IS THE PRESS USED IN BUILDING THE NEW BRITTANNIA BRIDGE.



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number 3 wires "or a tube section 1, or a 6-in wheel should have a fixed and definite signification. . . ." Though he called this classification, today his ideas sound more as if he were suggesting standardization.

Whewell called attention to the Crystal Palace exhibits of Joseph Whitworth (1803-1887), English mechanical engineer and inventor. Whitworth proposed a uniformity in the dimensions and fittings of machinery. He had carefully designed the members of the machines that he put on display so that they could be used as standard models for other manufacturers. Whitworth is remembered as the standardizer of screw threads—one widely used thread bearing his name today. Eli Whitney, Marc Brunel, Samuel Bentham, and others had conceived of interchangeability of parts, but Whewell and Whitworth were advocating standardization on an industry-wide basis.

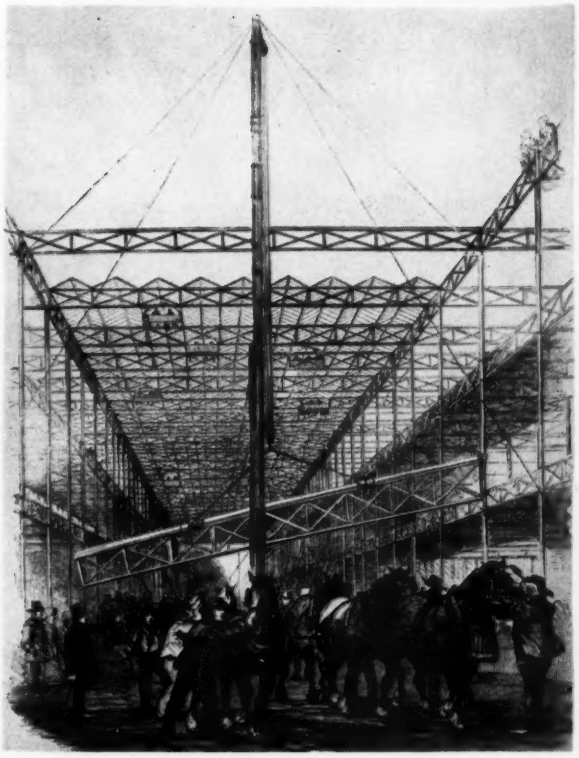
Although Whitworth was not the first to practice standardization and the Great Exhibition was not the first time that the practice had been brought before the public, Whewell's publicity, the Exhibition, and Whitworth's concepts are responsible, to a degree, for the widespread introduction of standardization. This conclusion is borne out by a statement of Whewell's, made before an audience who would have called him to account if he had been in error. He told the Society of Arts that if the names and distinctions of all tools and machines were fixed for good, this art should forever bear the impress of the Great Exhibition of 1851.

Technical Education

Whatever their particular approach or emphasis might have been, informed commentators, addressing a highly educated audience, in 1851, desired industry to use more advantageously the fruits of English science. There was general agreement that, though English industry might have assumed the position of leadership in the world, her position was not secure because the benefits that would be derived from art and ingenuity had been exhausted: science had to replace empiricism and art as the wellspring of inspiration and the motivation for industry. The over-all solution that would rectify and improve the situation would come, in the opinion of the critics, through a system of industrial and technical education which would bring the theoretical and practical together.

Writing almost a half-century after the Exhibition, Wemyss Reid, editor of the papers of Lyon Playfair, observed that the Great Exhibition had been the starting point in the scientific education of the Englishmen of industry. He felt that the stir created by the Crystal Palace had brought about a real revolution in the field of technical education.

Lyon Playfair, outstanding British chemist and member of Parliament, maintained, in 1851, that



THE CRYSTAL PALACE WAS AN ENGINEERING ACHIEVEMENT, BUT THE DESIGNER, JOSEPH PAXTON WAS NEITHER ARCHITECT, ENGINEER, OR SCIENTIST.

England needed an industrial university. France, he pointed out, annually graduated 150 young men from her Central College of Arts and Manufactures. Before entering this institution the youths had been trained in theoretical science enabling them to learn of its application to industry. America was following the continental system in offering university degrees in engineering. In contrast, the science curriculum in English universities and colleges terminated where that of the industrial colleges of France and the U. S. began. English students were never taught how to apply science. The industrial university, thought Playfair, ought to be given the power to grant a professional degree thus adding another profession to the three then existing in nineteenth century England.

Several persons lecturing before the Society of Arts thought the small technical schools such as the Royal College of Chemistry and the school of the Pharmaceutical Society set a better pattern for the teaching of applied sciences than the type of industrial university Playfair had in mind. These small schools, limiting themselves to technical training, had been designed especially to serve the needs of a particular industry; they did not aspire to award degrees and thereby create a formally trained profession. Sir Henry T. De la Beche, who spoke to the Society of Arts on mining, quarrying, and metallurgical processes, cited the School of Mines, lately opened at the Museum of Practical Geogra-

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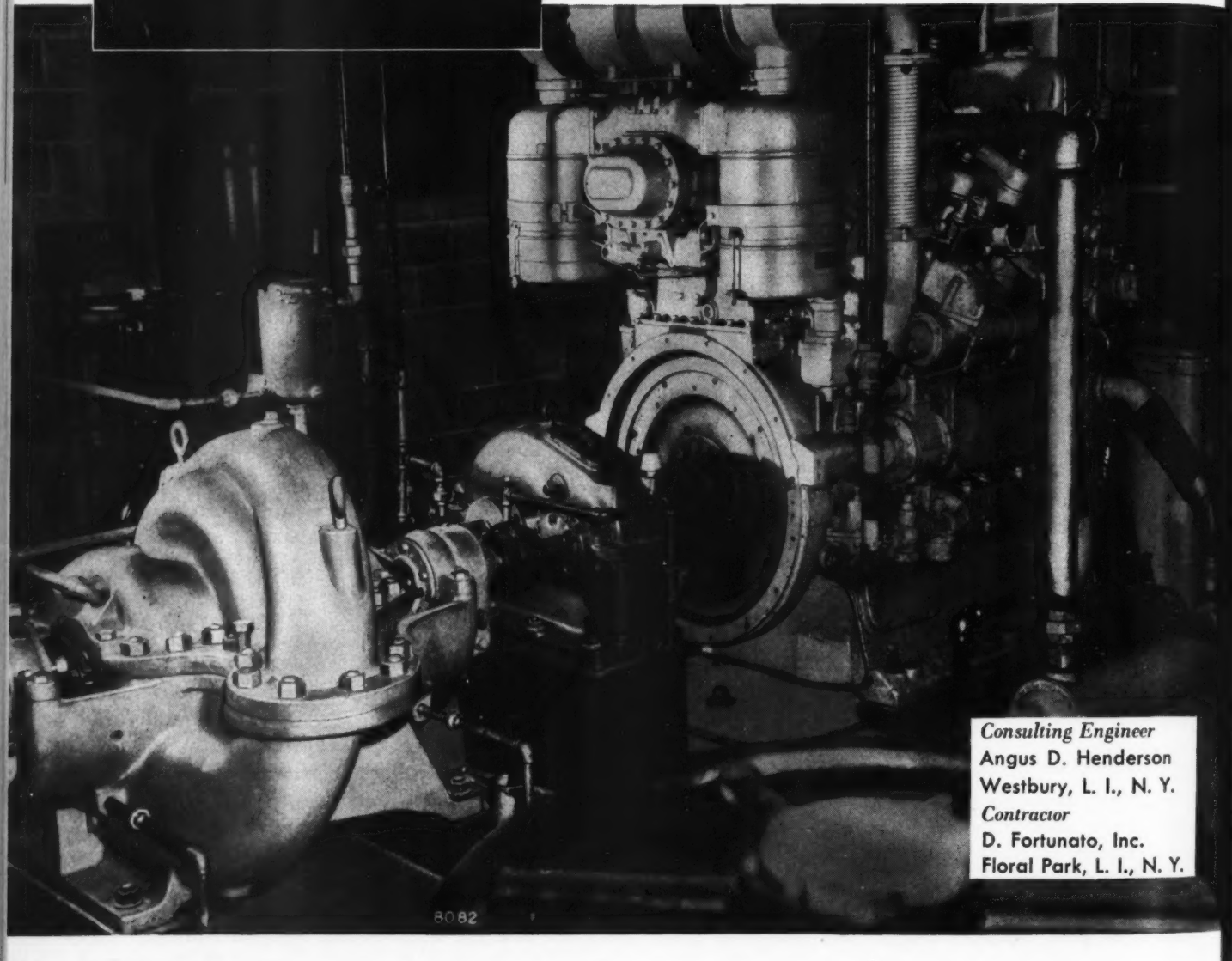

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phy, as an example of the type of school he would like to see introduced by educational reform.

A common omission made by the majority of commentators calling for a union of science and industry through education was a reference to the engineer. Not one of the lecturers before the Society of Arts foresaw that the engineer would be the man who would act as an intermediary between science and industry. This omission seems all the more unusual in light of the existence of a recent but active engineering group in 1851; the Institution of Civil Engineers had been founded in 1818, and by midcentury had a sizable membership.

"Free Practice"

At the time of the Exhibition, outside the lecture hall of the Society of Arts, the engineer was recognized, but the question was being debated as to whether engineers should be professionally trained under a scholastic system and awarded a diploma. In England any man could call himself an engineer and practice that occupation if he saw fit. This was called "free practice." *The Civil Engineer's and Architect's Journal* carried a lengthy article a few months after the closing of the Great Exhibition refuting Playfair's argument for industrial universities granting professional degrees.

The writer of the article maintained that the academic system appeared superior in theory but that in practice the "free system" was best. The names of the great English engineers had only to be called to mind to prove the merits of the "free system." Listed as evidence were Smeaton, Milne, Brindley, Watt, Trevithick, Jessop, Dodd, Rennie, Bell, Bramah, Murdock, Woolf, Telford, Stephenson, Huddart, Brown, and Galloway. Without formal academic training these men had made England the greatest industrial nation in the world.

Foreign engineers trained in the institutions abroad did not come to England to build and construct; instead, English engineers were in demand on the continent. This seemed to the writer in *The Civil Engineer's and Architect's Journal* an additional proof that the English system of training was superior to that of other nations.

There were those who argued that a grounding in physics, mathematics, and mechanics—and a diploma as well—should be required of the engineer because of collapsing bridges and retaining walls, exploding steam boilers, and piers that washed away; but these phenomena were said to be no more common in England than elsewhere. Formal training would do nothing to rectify the situation; only more practical experience.

The man of pure science had contributed little to industry, according to the opponents of formal scientific training for the engineer. Engineers not formally schooled had done not only vital scientific research but had made the important inventions and improvements as well. Finding a need for the rationalization of the principles of design and construction, engineers at their own initiative had improved the steam engine, determined the form of the screw propeller, and prepared the way for new bridge forms. The man of art and intuition developed theory when it was needed; he did not need the theoretical knowledge of scientists who had little experience in industry.

The Civil Engineer's and Architect's Journal was correct: English engineers in the past had produced and built more than their counterparts on the continent, but on the other hand, Lyon Playfair and those who called for more theoretical training, were charting the needs of the future. Only a person well-grounded in the science of strength of materials could build a safe structure with the barest minimum of materials—for materials would become more expensive; and only an individual well-trained in science could produce the achievements of modern chemistry; and only an individual familiar with the laws of physics could bring electricity to the service of mankind. As always, there would be the genius of such persons as Thomas Edison, proving exceptions to these rules, but there could never be enough Edisons to staff all the engineering jobs and laboratories that would come with the increased mechanization and the complexity of industry.

Despite the advocates of "free practice" and the opponents of rationalized industry, there was, after the Great Exhibition, an increased effort on the part of the scientist to generalize from the many isolated facts that had been discovered and to utilize these generalizations for the benefit of industry. The late Robert C. Binkley saw in the application of science to industry one of the chief characteristics of the 20-year period, 1852-71. In his opinion, it was not highly productive in pure science, but it was outstanding in the conscious application of scientific principles to technology. Also, there was an increased willingness on the part of the man of practice to listen to the scientist or the man of theory. Binkley believed that "one of the turning points in the relations of pure science to technology was undoubtedly the London Exhibition of 1851."

A Young Profession

Meanwhile, as England argued the question, the Continent and the United States were developing the concept of engineering as a profession that brought together the work of the pure scientist and the practical mechanic. It is only within recent years that England has accepted the idea that the engineer should hold a degree in engineering.

The engineer, today, who so often bewails his lack of professional standing should take heart from the knowledge that his is not an ancient profession, and that it has made rather amazing progress in the few years of its existence. ▲▲

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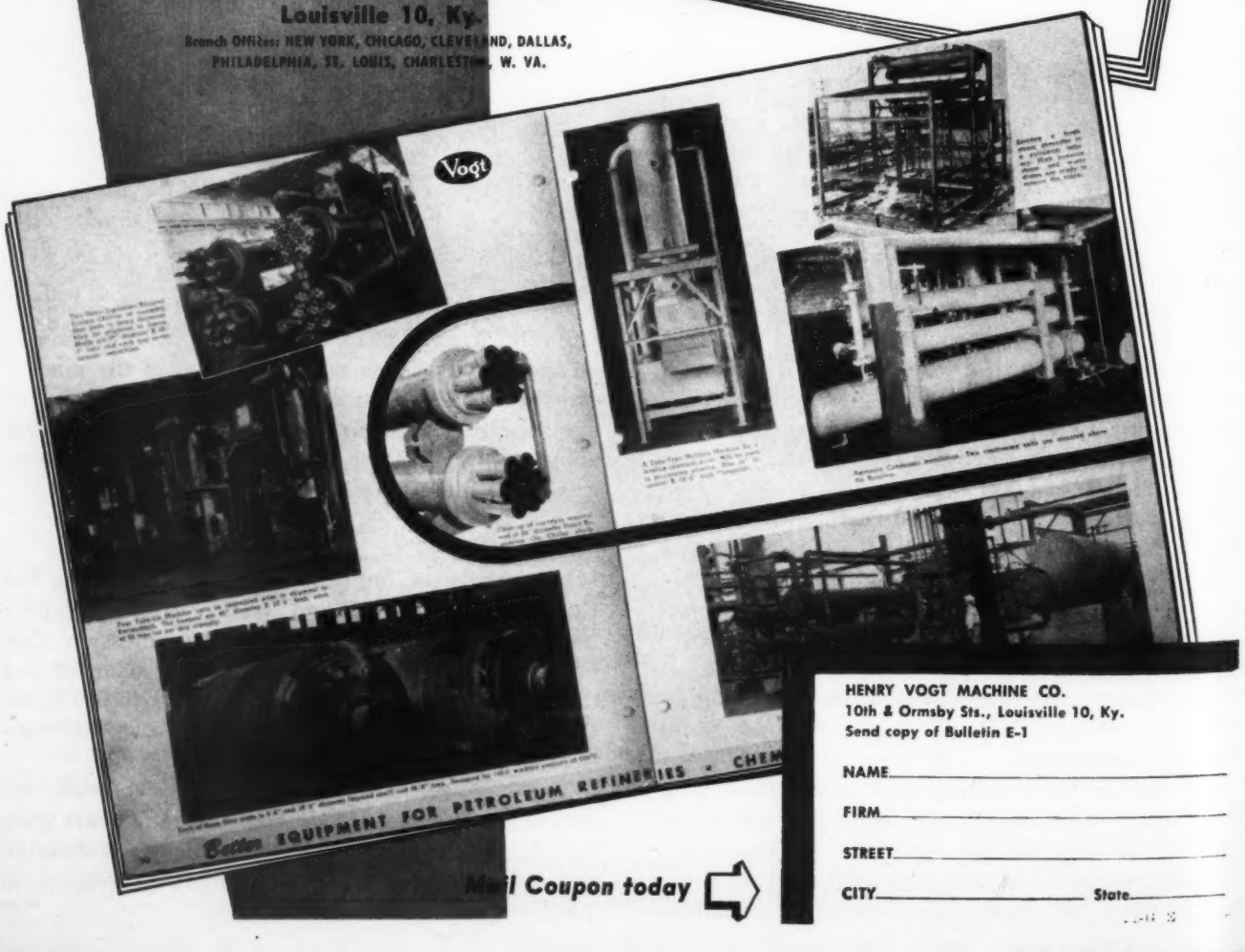

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Carelessness, laziness and just plain dumbness are the principal reasons engineers are found guilty of breach of warranty or negligence . . .

Engineers Can Be Wrong

ALBERT WOODRUFF GRAY

LIABILITY OF ENGINEERS, for mistakes in the preparation of plans and specifications, in advice given in consultations, or in the supervision of work, usually is covered by the same principles of law that hold a manufacturer liable for defective products.

Dual Liability

For his failure to exercise the necessary skill, the engineer becomes liable on two charges; breach of warranty, and negligence. This dual liability reminds one of a line in *Beggar's Opera,* "How happy could I be with either, were t'other dear charmer away."

The origin of the rule lies somewhere in the haze of forgetfulness of ancient English court records. Over 500 years ago, in the days of Henry IV, an English court held that "if a carpenter undertake to build a house and does it ill, an action will lie against him."

In another of these old lawsuits it was said, "Suppose I trust a shepherd with my sheep and he puts his own dog among them, which worries them. This would be a wrong although I contract with him for wages to take care of my sheep and he undertakes accordingly. In the case put of the shepherd he might either be charged upon a contract or as a wrong doer." (1)

In the construction of a 16-ft windmill on top of a barn in Indiana, the mill with its steel tower and frame weighed 2000 pounds. The barn was round, 100 feet in diameter, 34 feet to the eaves, with a conical roof rising to 70 feet. In the center of the barn an air shaft 4 or 5-ft wide, of heavy timber, extended through the roof. When the windmill collapsed leaving in its wake all that was once a barn, suit was brought against the engineer for negligence in his duty to construct this mill properly.

The Court Decision

"The general doctrine may be laid down thus; in every situation where a man undertakes to act or to pursue a particular course, he is under an implied legal obligation or duty to act with reasonable care, to the end that the person or property of others may not be injured by any force which he sets in operation or by any agency for which he is responsible.

"If he fails to exercise the degree of caution which the law requires in a particular situation he is held liable for any damage that results to another, just as if he had bound himself by an obligatory promise to exercise the required degree of care.

"In this view, statements so frequently seen in negligence cases to the effect that men are bound to act with due and reasonable care, are really vital and significant expressions. If there had been any remedial necessity for so declaring, it could obviously have been said without violence to principle, that men

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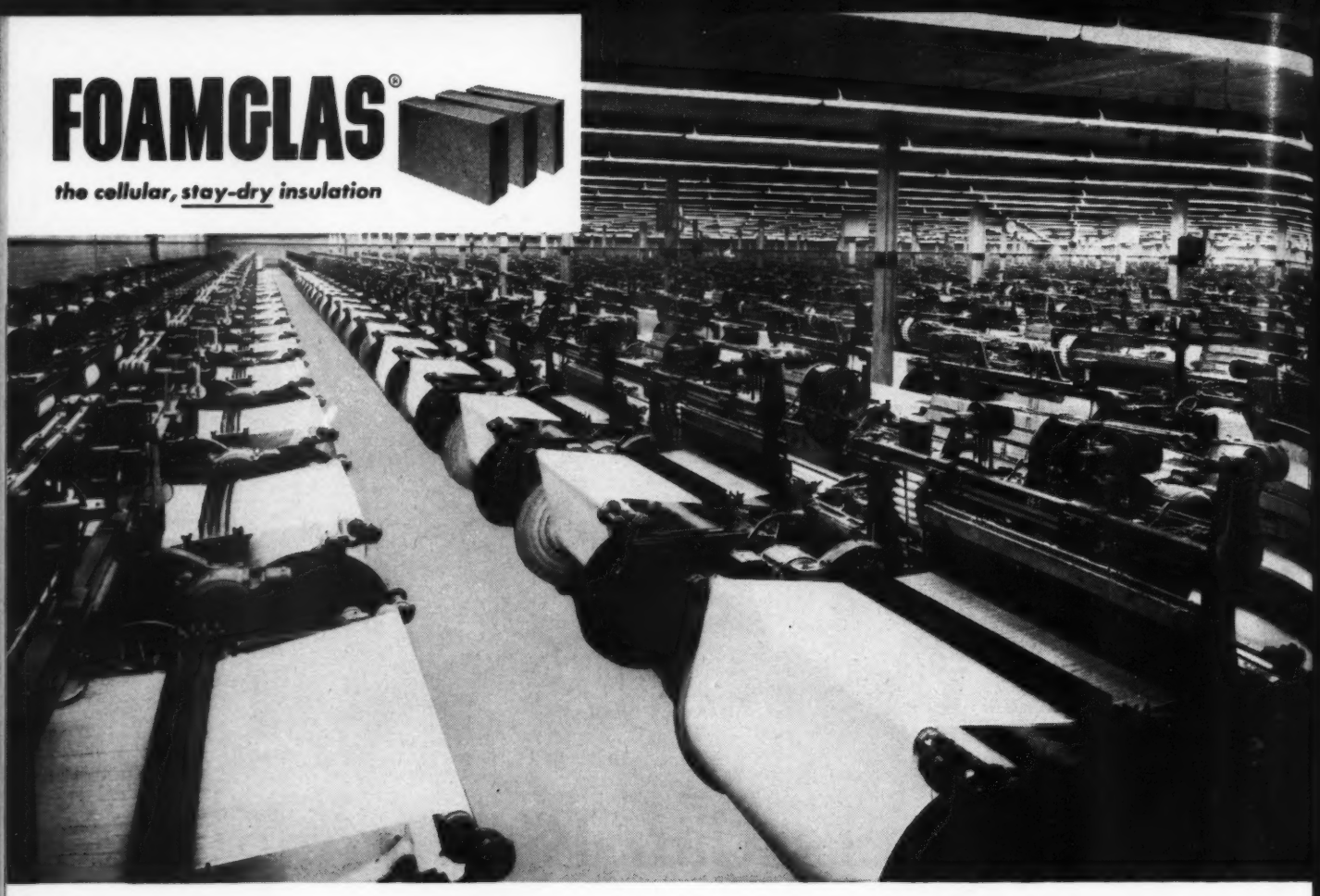


Now celebrating their 60th anniversary as a maker of top-quality print cloths, twills and broadcloths . . . Clinton Mills' broad textile manufacturing experience led them to rely on stay-dry FOAMGLAS to furnish dependable insulating protection for this 1300-loom weave room.

J. B. Templeton, Production Vice President, Clinton Cotton Mills, Clinton, S.C., reports . . .

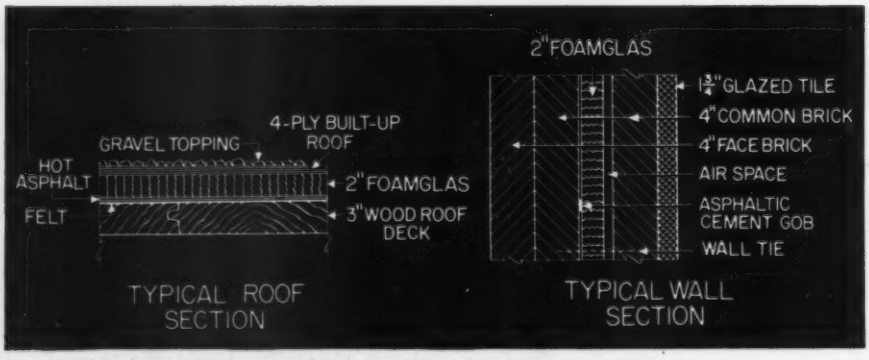
"FOAMGLAS roof and wall insulation stays dry, helps stabilize temperature-humidity to lower operating costs in this weave room"

When warp and filling yarns dry out and break, textile looms shut down. That cuts loom efficiency and boosts operating costs. The answer is constant, accurate temperature-humidity control to keep yarns workable. For such control, dependable insulation is a must!

"We picked FOAMGLAS to insulate roof and walls of the new 1300-loom weave room added to our Clinton, S.C., mill last year," says J. B. Templeton, Production Vice President of Clinton Cotton Mills. With its structure of closed glass cells, FOAMGLAS can't absorb moisture and lose efficiency as other insulations do. It stays dry and effective.

Mr. Templeton concludes: "FOAMGLAS aids in maintaining dependable temperature-humidity control. Yarn fibers stay moist, workable and free from static electricity. Condensation on weave room walls and ceiling is eliminated. Our looms operate at or near rated capacity with minimum shutdowns."

You'll profit, too, when you insulate roofs, ceilings, walls, piping or equipment with *stay-dry* FOAMGLAS. It's completely inorganic—therefore rotproof, fire-proof and acid-proof. It's strong, rigid and dimensionally stable, too. Prove it! Send today for a free sample and directions for six simple tests—easily performed in your own office. Prove to yourself that FOAMGLAS is *your* ideal insulation! Write—



Drawings show application of FOAMGLAS on roof and walls of Clinton Mills' new weave room. Since the insulation prevents condensation, there is no danger of moisture damage to walls, roof, window frames or floors.

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who undertake to act are subject to a fictitious or implied promise to act with care."[2]

This ancient rule of law that an engineer is liable in damages for the cost of completing a structure that is found wanting as a result of the engineer's failure to exercise the necessary professional skill, governed a case brought before the Missouri courts. Two buildings had been designed in Kansas City, for use in the storage of heavy chemicals. Floors were to bear a load of 250 pounds per square foot, but the floors had collapsed.

In its decision that the owners were entitled to recover the expense necessary to fill this specification, the Supreme Court of that State said of the failure of the engineers to use proper skill in the performance of this work:

"If they represented themselves as experienced and skillful in the construction of buildings and in the designs for such buildings and the owners relied upon their judgment and they undertook the construction of the building, then the implied warranty arose that in design and workmanship the building should be reasonably fit for the purpose designed."[3]

Scaffolding Fails

A decision of the Supreme Court of the United States makes use of this same doctrine of law, but in this instance the suit is brought against a contractor rather than an engineer.

In the construction of a bridge across the Maumee River at Toledo, Ohio, the work had been taken over by a second contractor before the bridge had been completed. Of the existing structure and the work of the first contractor, the successor company agreed, "to assume and pay for all work done and materials furnished up to the time of executing this contract, including piling and piles, timber and other materials, and labor done on same."

Three spans, each 175 feet in length and resting on stone piers, and a draw span of 185 feet made up the bridge. Soon after the construction work had been assumed by this second contracting firm, the scaffolding supporting one of these spans collapsed, and the supports for the second — along with the construction work already done — were swept away by ice.

In awarding a judgment against the first contractor for this defective construction, the Supreme Court followed the rule of law for damages awarded for defects occurring in a manufactured product when reliance is placed by the purchaser on the skill and judgment of the manufacturer.

"The transaction was in effect a sale of this false work constructed by a company whose business it was to do such work, to be used in the same way the maker intended to use it and the latent defects, as the maker knew, the buyer could not by any inspection or examination at the time discover.

"The buyer did not, because in the nature of things he could not, rely on his own judgment; and in view of the circumstances of the case and the relations of the parties, he must be deemed to have relied on the judgment of the company, which alone of the parties to the contract, had or could have knowledge of the manner in which the work had been done.

"The law therefore implied a warranty that this false work was reasonably suitable for such use as was contemplated by both parties. It was constructed for a particular purpose and sold to accomplish that purpose. And it is intrinsically just that the company which held itself out as possessing the requisite skill to do work of that kind, and therefore as having special knowledge of its own workmanship, should be held to indemnify its vendee against latent defects arising from the mode of construction and which the latter, as the company well knew, could not by inspection discover for himself."[4]

Specifications Should Be Right

Another incident of interest occurred recently in New York State. The case points up the need for engineering knowledge in the writing of specifications. Plans and specifications for a 78-in. sewer in a 2-mile tunnel 40 feet below the surface, had been detailed by Westchester County in a construction contract. These specifications required the use by the contractor of the facilities and methods adapted to the construction of a fresh air tunnel, such as alignment holes specified in detail for checking direction. They were entirely inadequate and useless in tunnel construction under compressed air.

In the construction of three-quarters of this tunnel, compressed air was necessary at a cost over free air of $497,521.25. This additional amount over the sum specified in the contract was awarded the contractor in a suit brought against the county. In its decision the Federal Court said:

"The stipulation that these free air methods be used was a representation that the job was free air tunnel construction work. Where one party furnishes specifications and plans for a contractor to follow in a construction job he thereby impliedly warrants their sufficiency for the purpose in view. The specifications outlined above would be adequate only where the tunnel was to be built in free air. Thus the county, setting out these specifications to be followed, impliedly warranted that the tunnel was substantially a free air job.

"Whether the builder was damaged in proceeding with the work in reliance on this implied warranty, or whether he was damaged in relying on the warranty in making his bid, he may recover."[5]

Inaccurate Survey

In a decision in Connecticut against a civil engineer for negligence, the court made a comment on the thoroughness necessary in the work of an engineer for adequate performance. This engineer had run a line 14 inches beyond the actual boundary in

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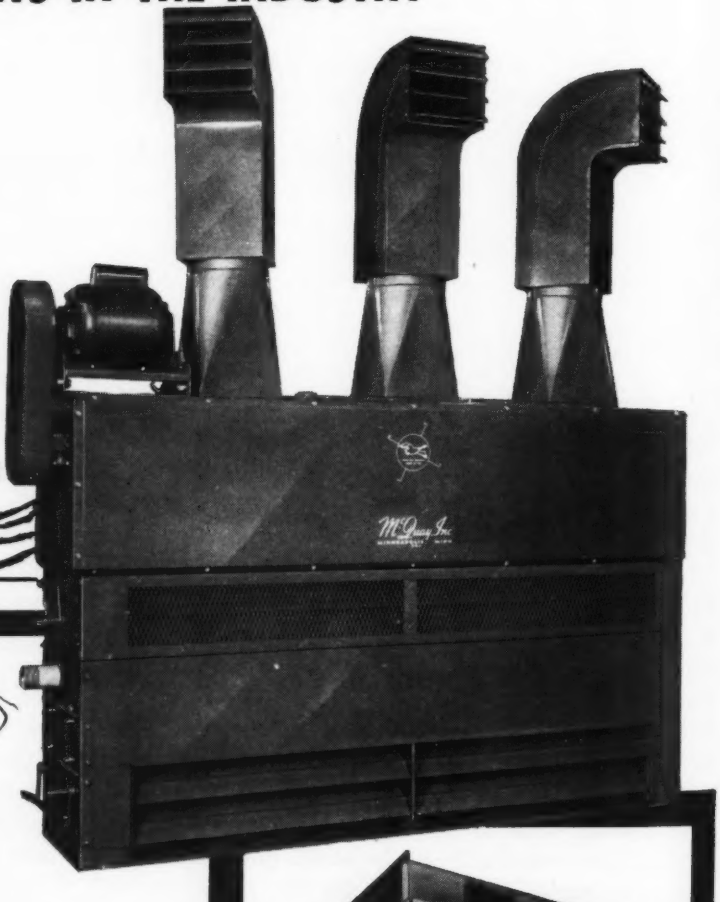

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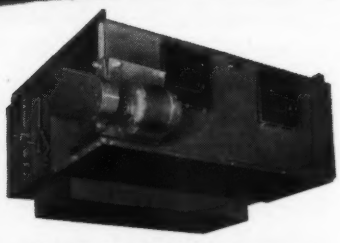

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an effort to establish the exact boundary of land on which a building in New Haven could be constructed. It was intended that this building should occupy the entire lot. Construction of the building met with an ejectment action by the adjacent owner, and the matter was settled by the payment of damages for the encroachment.

In its decision of the suit, brought by the owner against the engineer to recover these damages, the court said:

"Having accepted the service from the owner of the property, he was bound to exercise that degree of care which a skilled engineer of ordinary prudence would have exercised under similar circumstances. Might he simply examine the land records and muniments of title and observe the fixed monuments and evidences of the present occupancy and ownership or was he bound to scour the neighborhood to learn whether there had been adverse occupancy and claims of ownership of any part of the premises by others? Would good engineering practice require that he examine a city engineer's map, the failure to examine which was claimed to constitute negligence on the part of the engineer?" (6)

Implied Warranty

This principle of law is a general one governing any circumstances of this character and is by no means confined solely to engineers. As one authority has stated:

"Ordinarily a person undertaking a particular work impliedly agrees to exercise a degree of skill equal to the undertaking although in determining the amount of skill which the promissor must bring to bear, it is proper to take into consideration the knowledge which the promisee has of his qualifications for the work undertaken. So in case a person holds himself out as specially qualified to perform work of a particular character there is an implied warranty that the work which he undertakes shall be of proper workmanship and reasonably fit for its intended use."

Nevertheless, when an engineer submits plans or specifications or undertakes to supervise the performance of a contract, he is no more an insurer of the successful performance of the work than is a physician of the success of his efforts in effecting a recovery of a patient. Like the physician, the engineer impliedly guarantees only that he is reasonably equipped with the knowledge and experience necessary for the undertaking.

There is, in addition, the further ground of negligence, on which an engineer, in spite of adequate skill and knowledge, may be held responsible for damages arising from errors in specifications or faulty plans.

Suit was brought, in South Carolina, some years ago against an architect for failing properly to supervise the construction of a house. Areas of plaster had fallen from the ceilings and it was discovered that the plaster varied from ½ to 3¾ inches in thickness. Of the negligence of the architect in the performance of his services, which are legally identical in character with those of engineers, the South Carolina Court said:

"Where one employs an architect to draw plans for a house and to supervise the construction, such architect is bound under the law to exercise reasonable care and reasonable diligence to see that the work is done in a reasonable, proper, safe, and secure manner.

"If the architect carelessly fails to supervise the construction of the house which he is employed to supervise and carelessly allows improper material to go into the house or carelessly allows improper work to be done on the house, he is responsible in damages to the person who employs him to supervise said work. If he fails either to supervise the work as it is being carried on or in supervising the materials which go into the house, he is liable for the damages to the one who employs him." (7)

Improper Supervision

Similar circumstances recently were involved in a lawsuit before another South Carolina Court. There suit had been brought for damages for the failure of an engineer to properly supervise construction of a food freezing plant. Within 3 or 4 weeks after the cooling process had been turned on, pin cracks appeared in the concrete floor, gradually increasing in size until by the end of the first year they were approximately 3-in. wide. Walls cracked and in some places the floor warped as much as 7 inches.

In sustaining a judgment for damages in a suit brought against this engineer, the Supreme Court of that State, basing its decision on the determination of the earlier suit against the architect, said in awarding a judgment against this engineer:

"It seems to be well settled that where a person holds himself out as specifically qualified to perform work of a particular character, there is an implied warranty that the work which he undertakes shall be of proper workmanship and reasonable fitness for its intended use, and if a party furnishes specifications and plans for a contractor to follow in a construction job he thereby warrants their sufficiency for the purpose in view." (8)

Lack of Skill

Recently, in excavating the foundation of a building in Missoula, Montana, the wall of the adjacent building collapsed. In a suit by the owner of this adjacent building it was contended that in making this excavation, reasonable skill had not been used and that from the lack of adequate support the building collapsed. Here in referring to the two grounds on which an engineer may be held liable for damages—negligence and breach of an implied warranty—

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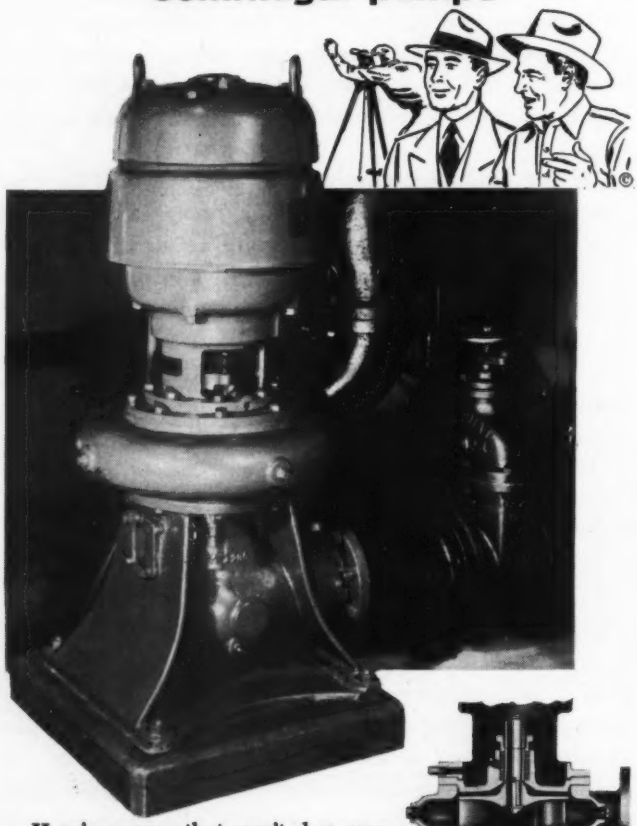

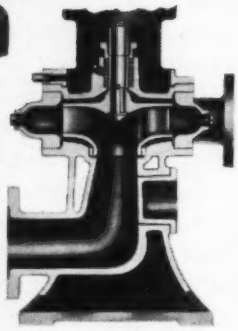

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the court called attention to the absence of any essential difference between them.

"The firmly established rule is that for injuries resulting from unskillful or otherwise negligent performance of a thing agreed to be done, an action for negligence will lie, notwithstanding the act complained of would also be ground for an action for breach of contract.

"Although there is a broad distinction between the causes of action arising from a breach of contract and those arising from negligence, the dividing line between breaches of contract and negligence often lies in the twilight where it is difficult to determine whether the case applied strictly to the one or the other.

"Under certain circumstances a ground for liability for negligence may coexist with a liability in contract, giving the injured party the right to elect which form of action he will pursue. Ordinarily, where there is no duty except such as the contract creates, the injured person's remedy is for breach of contract, but when the breach of duty arises out of a liability independently of the personal obligation undertaken by contract, it is a wrong.

"As a general rule there must be some active or wrong doing to support a negligence action. There must be some breach of duty distinct from breach of contract."

Care and Competence

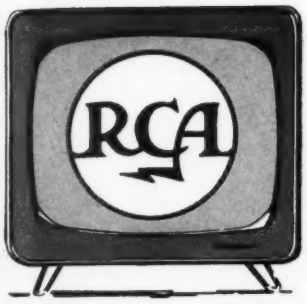
Before the California Supreme Court a few months ago there came for review the decision of a lower court holding a test driller responsible for a report in which he falsely stated that there was no fill below 16 inches at a plot of building lots.

"The services of experts," said the court sustaining the judgment against this test driller, "are sought because of their special skill. They have a duty to exercise the ordinary skill and competence of members of their profession, and a failure to discharge that duty will subject them to liability for negligence.

"Those who hire such persons are not justified in expecting infallibility but can expect only reasonable care and competence. They purchase service, not insurance."[9] ▲▲

REFERENCES

1 Dickon v. Clifton, 2 Wills 319 (English)
2 Flint & Walling Mfg. Co. v. Beckett, 79 N.E. 503: 12 L.R.A. (N.S.) 924, Indiana
3 Kennedy v. Bowling, 4 S.W.2d 438, Missouri
4 Kellogg Bridge Co. v. Hamilton, 110 U. 108
5 Montrose Contracting Co. v. County of Westchester, 80 Fed. 2d 841, New York
6 Ferrie v. Sperry, 82 Atl. 577, Connecticut
7 Avent v. Profitt, 95 S.E. 134, South Carolina
8 Hill v. Polar Pantries, 64 S.E.2d 885, South Carolina
9 Gagne v. Bertran, 275 Pac. 2d 15, California



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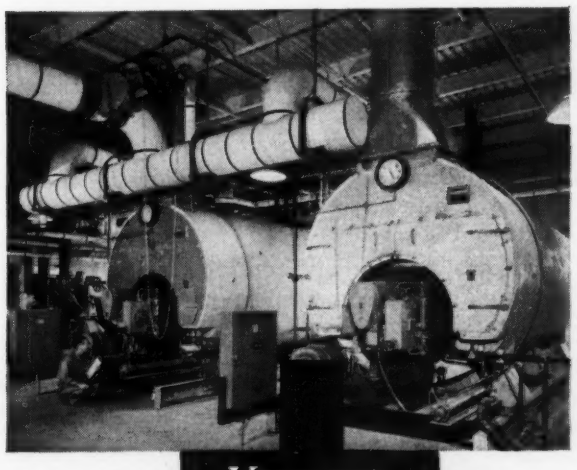

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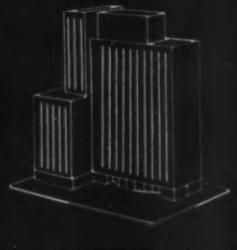

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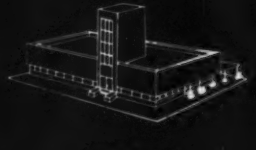

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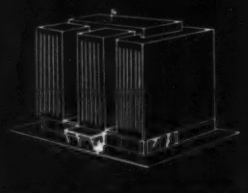

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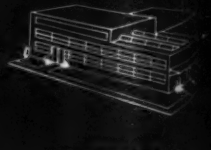

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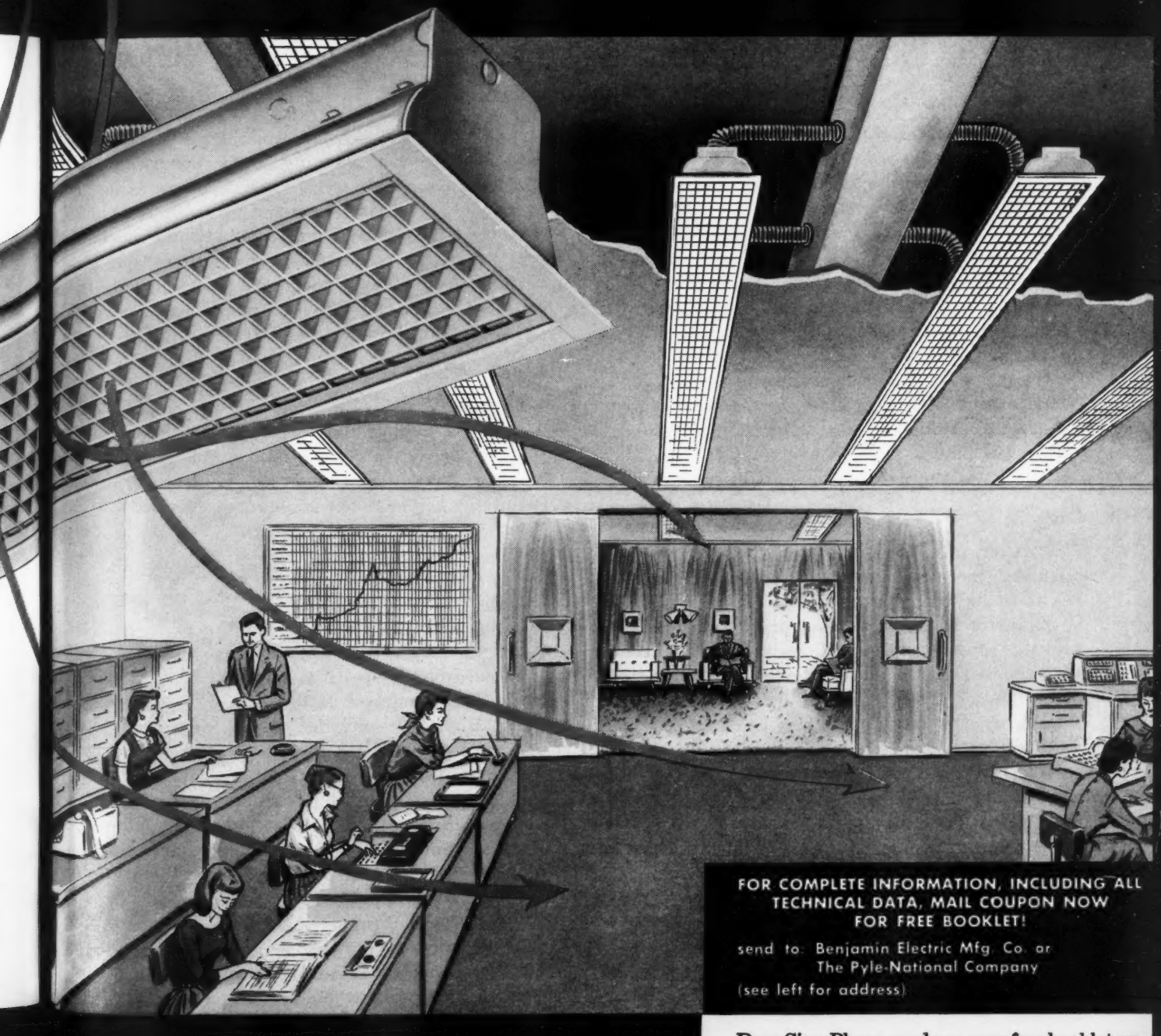

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Approximate Required NPSH

IGOR J. KARASSIK and T. W. EDWARDS
Asst. to Vice President Consulting Engineer Worthington
Manager Boiler Feed Pump Sect. Corporation

THERE IS CONSIDERABLE literature available on the subject of Net Positive Suction Head (NPSH) with reference to the system in which a high pressure boiler feed pump is to operate, that is, how to figure available NPSH for a particular pumping application. The consulting engineer, therefore, can determine the NPSH that he actually has available. From the pump manufacturer's curve (see Fig. 1) he can ascertain the adequacy of his available NPSH for the particular pump he wishes to specify. If the NPSH available is inadequate, he can take steps to increase it through system alteration, or he can change his pump selection to equipment requiring less NPSH at the desired flow conditions.

Costly Delay

However, until the pump manufacturer has been consulted, there is little that the consulting engineer can do to approximate the NPSH that probably will be required. He must depend upon his experience gained through past applications of a similar nature. With the constant increase of boiler feed pump sizes, necessitated by higher boiler flows, his guess, although educated, very likely may be on the low side. By the time a pump manufacturer has been consulted, basic planning, layout work, and possibly some actual construction may have progressed to the point where alterations are extremely expensive. The engineer then may be faced with the problem of having to actually make these expensive changes in his planning or construction work.

As an alternate he may be forced to purchase an oversized boiler feed pump especially designed for low NPSH applications. This special pump probably will be more expensive than a standard piece of equipment, and delivery may be long. Also, other desirable hydraulic characteristics may have to be compromised to get the unusually low NPSH. In extreme cases, the pump may have to be of a low speed design popular 15 to 20 years ago but no longer generally used for boiler feed application. In essence, then, the consulting engineer may have no choice but to specify an obsolete design.

It would appear advantageous if the engineer, in the initial stages of planning, could approximate the NPSH that probably will be required just as he approximates his desired flow and probable total head characteristics. Since design methods and constants vary widely between manufacturers, there is no universally accurate way to do this. Yet knowing the type of pump to be purchased for the application, he can approximate the value of NPSH required.

Suction Specific Speed

This method involves the use of a parameter known as Suction Specific Speed. Just as pump specific speed is a comparative number and is indicative of pump type, so is Suction Specific Speed essentially a nondimensional number, defined as:

$$S = \frac{N\sqrt{Q}}{H_s^{3/4}}$$

where:
Q is the flow in gallons per minute to be pumped through the eye of the first-stage impeller.
N is the rotative speed in rpm.
H_s is NPSH required in feet.

Fig. 2 has been included to provide for easy conversion of H_s to $H_s^{3/4}$. Note also, that with single-suction impellers, Q is the total flow. Where double-suction first-stage impellers are involved, Q is equal to one-half the total flow. Where the inlet and outlet flows are not equal, such as where a take-off at an intermediate pressure is involved, use the gross inlet flow in computing the NPSH required.

In using this formula, the proper selection of the S value will determine the accuracy of the required NPSH so calculated. The Hydraulic Institute Standards for high pressure boiler feed pump applications (over 1000 psi developed pressure) are based upon S equal to 7000 at the capacity corresponding to the point of best efficiency. This is quite conservative and may unnecessarily penalize a proposed system cost-wise. Values of 8000 are quite common, and centrifugal boiler feed pumps producing S values up to 10,000 are in successful operation. Fig. 3 is a

(Text continues on page 95)

Figure I

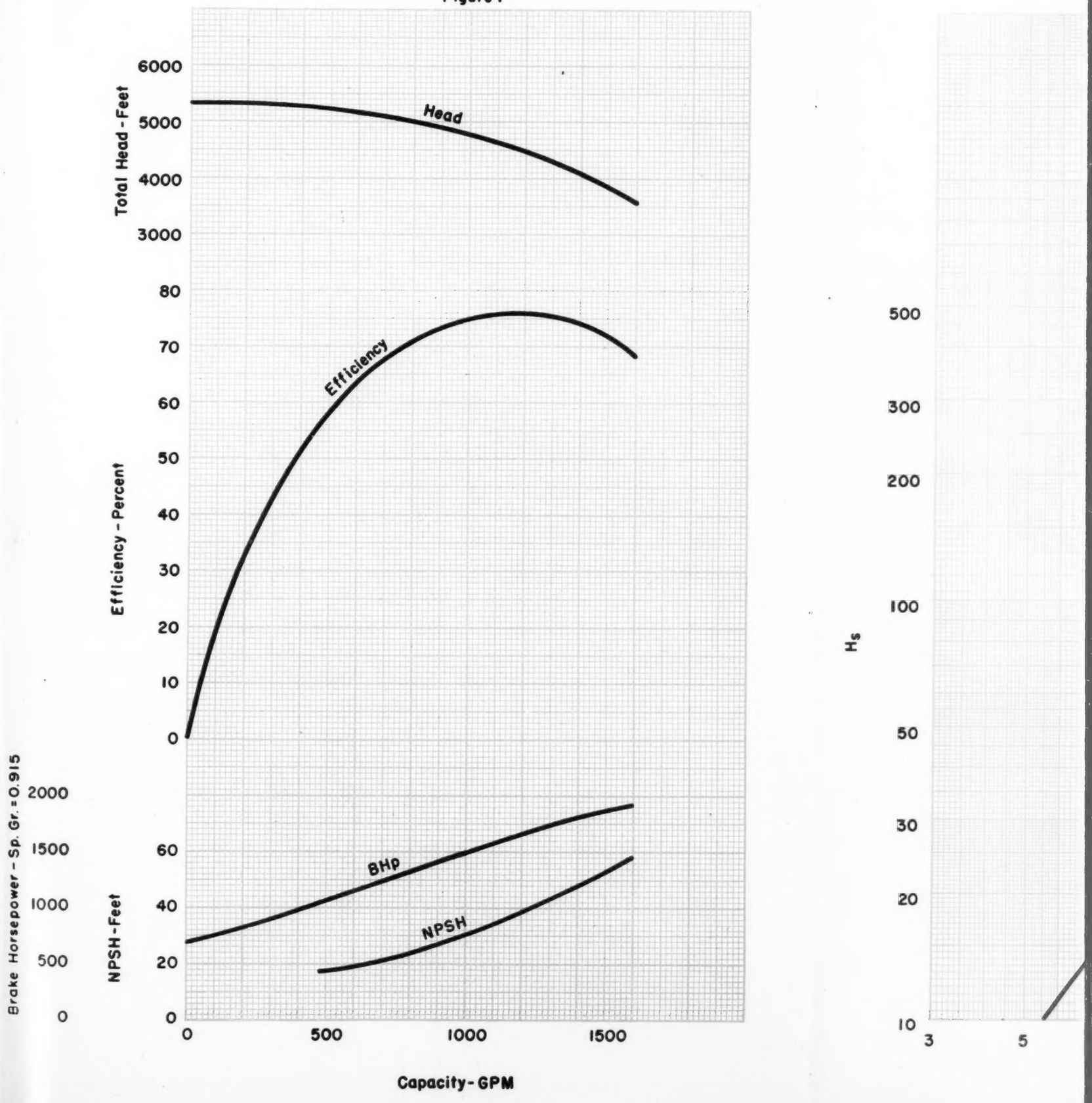
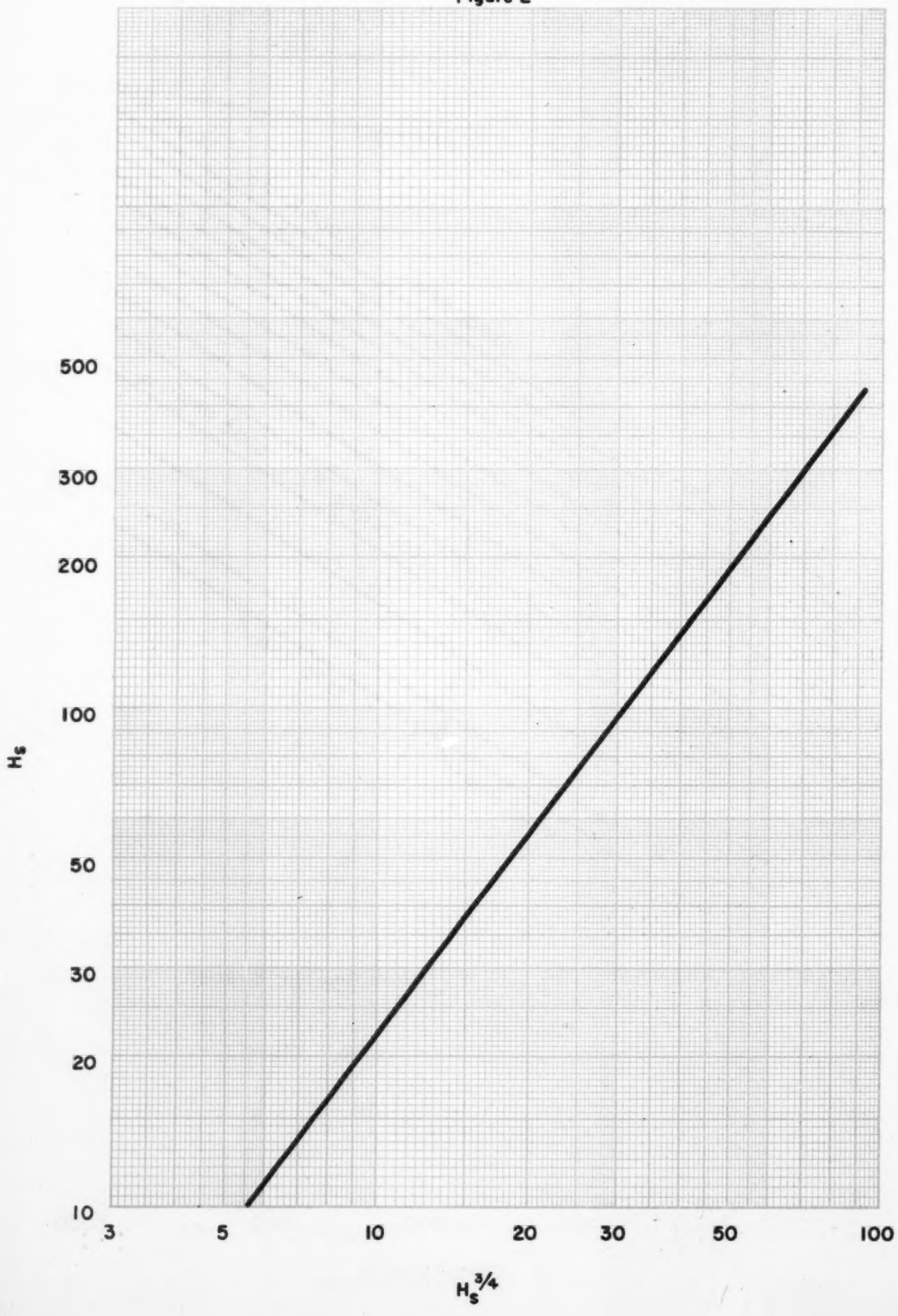

Total Head - Feet
6000
5000
4000
3000
Head
Efficiency - Percent
80
70
60
50
40
30
20
10
0
Efficiency
Brake Horsepower - Sp. Gr. = 0.915
2000
1500
1000
500
0
BHp
NPSH - Feet
60
40
20
0
NPSH
0
500
1000
1500
Capacity - GPM
Hs
500
300
200
100
50
30
20
10
3
5

Figure 2



Required Net Positive Suction Head—Feet

Figure 3

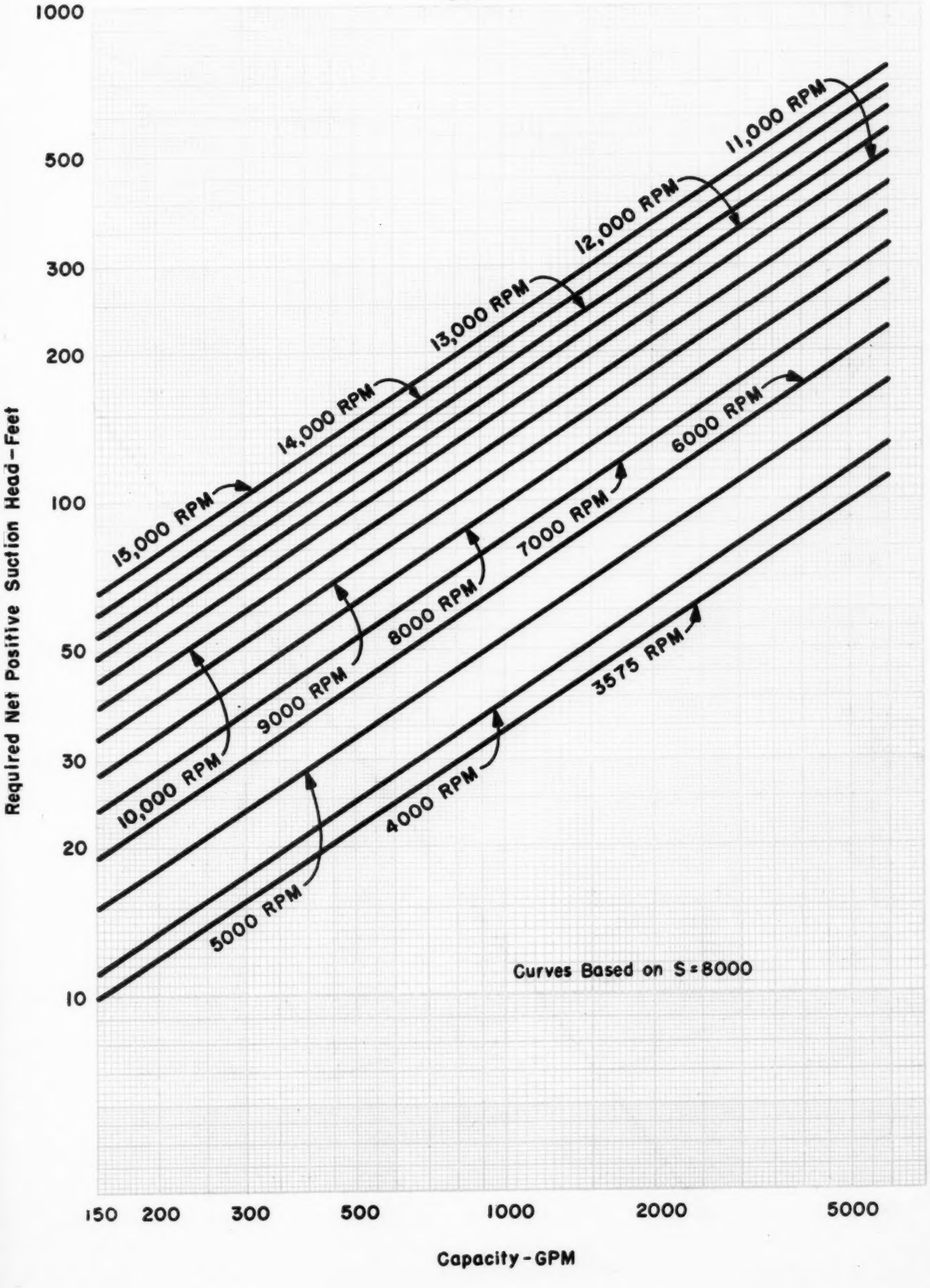

1000
500
300
200
100
50
30
20
10
Required Net Positive Suction Head – Feet
15,000 RPM
14,000 RPM
13,000 RPM
12,000 RPM
11,000 RPM
10,000 RPM
9000 RPM
8000 RPM
7000 RPM
6000 RPM
5000 RPM
4000 RPM
3575 RPM
Curves Based on S = 8000
150
200
300
500
1000
2000
5000
Capacity - GPM

Figure 4

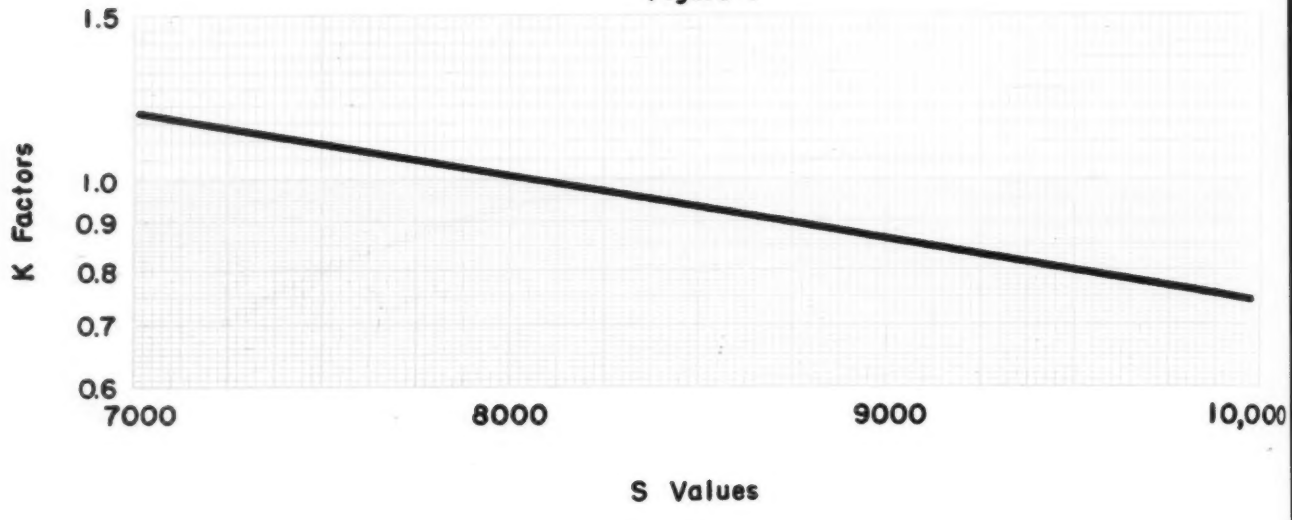
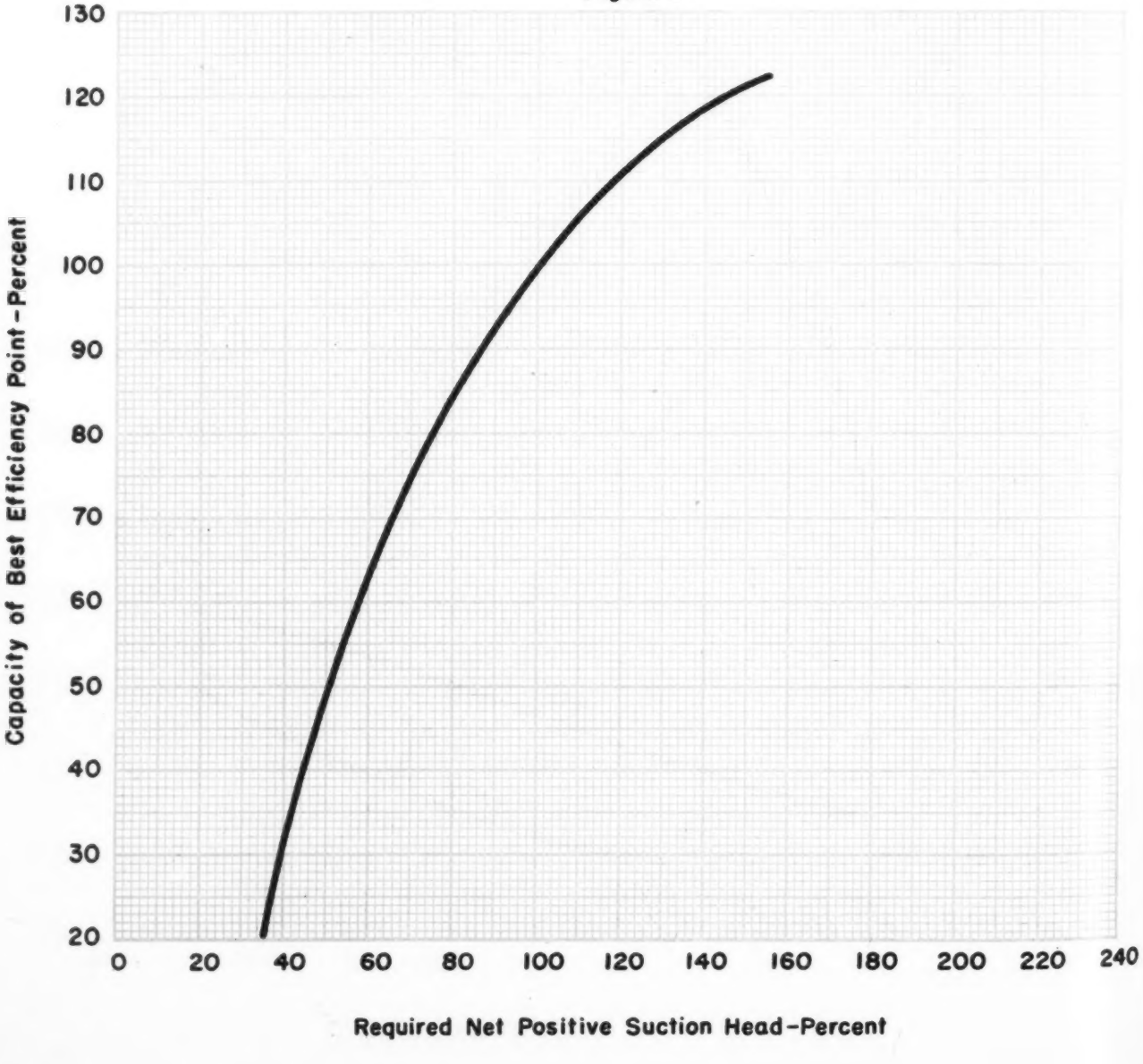


Figure 5



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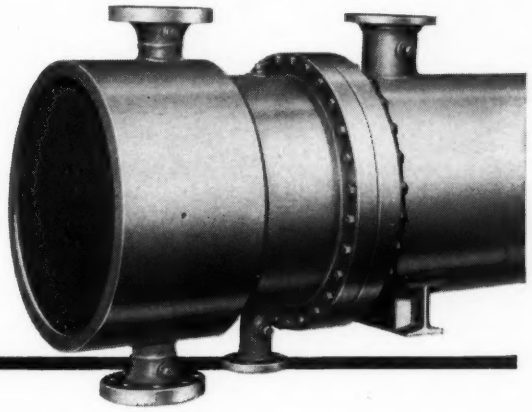

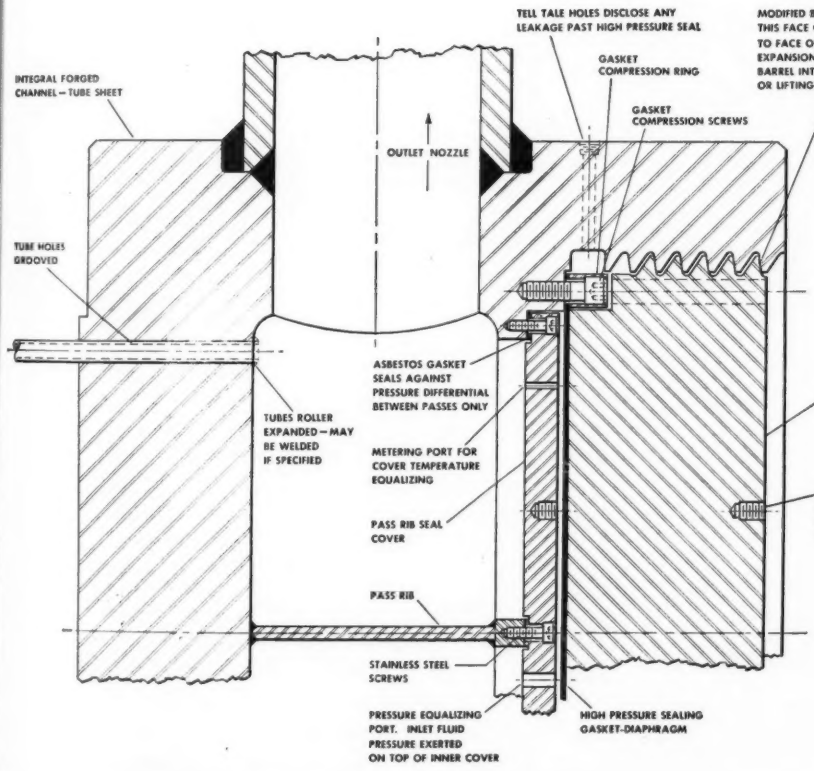
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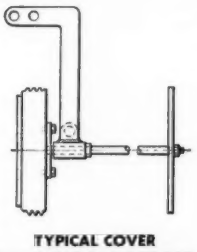
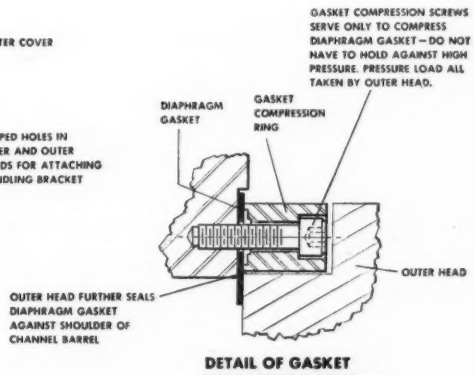
MODIFIED BUTTRESS THREAD. THIS FACE OF THREAD PARALLEL TO FACE OF HEAD. DIFFERENTIAL EXPANSION BETWEEN HEAD AND BARREL INTRODUCES NO WEDGING OR LIFTING ACTION IN HEAD
INTEGRAL FORGED CHANNEL – TUBE SHEET
GASKET COMPRESSION SCREWS
OUTLET NOZZLE
TUBE HOLES GROOVED
ASBESTOS GASKET SEALS AGAINST PRESSURE DIFFERENTIAL BETWEEN PASSES ONLY
OUTER COVER
TUBES ROLLER EXPANDED – MAY BE WELDED IF SPECIFIED
METERING PORT FOR COVER TEMPERATURE EQUALIZING
TAPPED HOLES IN INNER AND OUTER HEADS FOR ATTACHING HANDLING BRACKET
PASS RIB SEAL COVER
PASS RIB
STAINLESS STEEL SCREWS
PRESSURE EQUALIZING PORT. INLET FLUID PRESSURE EXERTED ON TOP OF INNER COVER
HIGH PRESSURE SEALING GASKET-DIAPHRAGM



TYPICAL COVER HANDLING BRACKET FOR HORIZONTAL UNIT


GASKET COMPRESSION SCREWS SERVE ONLY TO COMPRESS DIAPHRAGM GASKET – DO NOT HAVE TO HOLD AGAINST HIGH PRESSURE. PRESSURE LOAD ALL TAKEN BY OUTER HEAD.
DIAPHRAGM GASKET
GASKET COMPRESSION RING
OUTER HEAD
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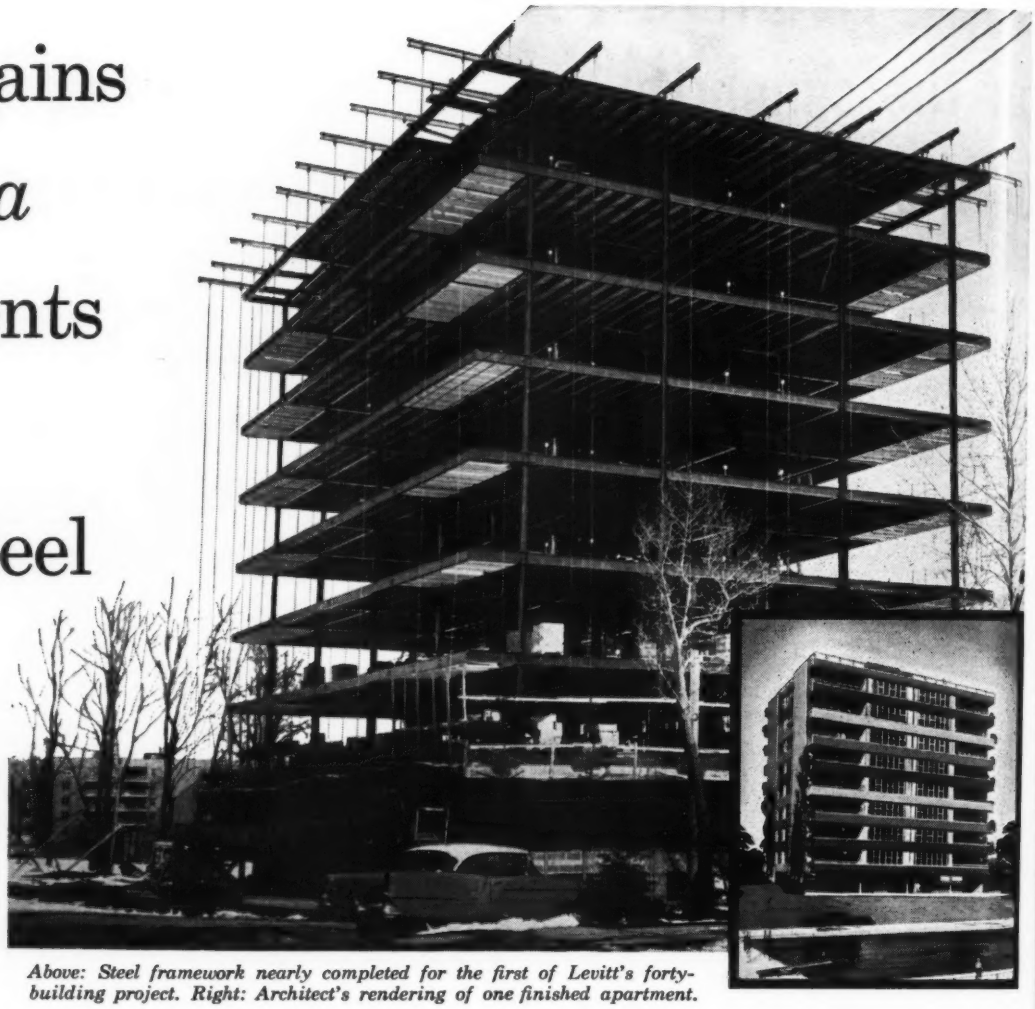
Levitt gains 160 *extra* apartments using Stran-Steel joists



Above: Steel framework nearly completed for the first of Levitt's forty-building project. Right: Architect's rendering of one finished apartment.

Zoning height restrictions in the Borough of Queens, New York, would have limited the luxuriously planned Levitt apartment-community buildings to only seven floors, using ordinary construction. But, by using new Stran-Steel 10-inch nailable joists, 2½″ of height was eliminated per floor making it possible for each of the forty buildings to be eight stories high and well within the zoning limitations.

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In addition to saving space, Stran-Steel joists make possible other important economies. For example, the Levitt buildings require less steel tonnage because the joists are lightweight but furnish all the strength required. Exterior brick work requires one less course of bricks per floor. And for interior flooring, precast concrete slabs are nailed directly to the joists. This time- and labor-saving feature is made possible by the exclusive nailable design of Stran-Steel joists.

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chart for determining NPSH required values based upon an S value of 8000.

Fig. 4 gives a K factor which can be used to convert results obtained from Fig. 3 for other S values from 7000 to 10,000. This K factor is based upon the following derivation, in which subscript "a" refers to values of S = 8000, and subscript "b" refers to a selected value of S.

$$H_{Sa}^{3/4} = \frac{N\sqrt{Q}}{8000} \text{ ; and } H_{Sb}^{3/4} = \frac{N\sqrt{Q}}{S_b}$$

Since N and Q are constant:

$$S_b H_{Sb}^{3/4} = 8000 H_{Sa}^{3/4}$$

$$H_{Sb}^{3/4} = H_{Sa}^{3/4} \left(\frac{8000}{S_b}\right)$$

$$H_{Sb} = H_{Sa} \left(\frac{8000}{S_b}\right)^{4/3}$$

Let $$K = \left(\frac{8000}{S_b}\right)^{4/3}$$

Then $$H_{Sb} = KH_{Sa}$$

This is the K given in Fig. 4.

While, for a particular design, the S value at the point of best efficiency is fixed, there are available to the pump manufacturers several methods for attaining NPSH improvement. The NPSH required by a pump at equivalent operating points on its curve varies approximately as the square of a speed change. Therefore, selection of operating speeds can be a very important factor in determining NPSH requirements. With high speed pumps (over 4000 rpm), for example, an adequate NPSH produced through static elevation alone frequently is found to be prohibitive since the required height is so great. For this reason, most such high speed boiler feed pumps require booster pumps to produce an adequate NPSH. The fact that NPSH varies as the square of a speed change can be demonstrated as follows:

$$S = \frac{N_1\sqrt{Q_1}}{H_{S_1}^{3/4}} = \frac{N_2\sqrt{Q_2}}{H_{S_2}^{3/4}}$$

$$\left(\frac{H_{S_2}}{H_{S_1}}\right)^{3/4} = \frac{N_2\sqrt{Q_2}}{N_1\sqrt{Q_1}}$$

But, $$\frac{Q_2}{Q_1} = \frac{N_2}{N_1}$$

Therefore: $$\left(\frac{H_{S_2}}{H_{S_1}}\right)^{3/4} = \frac{N_2^{3/2}}{N_1^{3/2}}$$

And $$\frac{H_{S_2}}{H_{S_1}} = \left(\frac{N_2}{N_1}\right)^2$$

For example, referring to Fig. 1, the pump at 3575 rpm is designed for 1200 gpm against a total head of 4500 feet. At this point, 38 feet of NPSH is required. Now, speed this pump up to 4000 rpm. The equivalent operating point is 1342 gpm at a total head of 5640 feet. At this speed and operating point, the pump requires 47.5 feet of NPSH.

Impeller Design

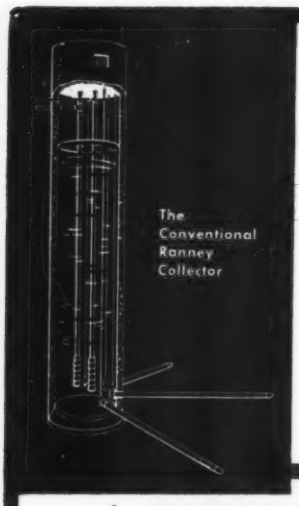
Of course, it goes without saying that impeller design affects required NPSH. However, the latitude available to the designer is limited, since the particular impeller design must meet many requirements — not just NPSH. In boiler feed pumps, shaft diameter affects NPSH characteristics. The larger the shaft diameter at the impeller eye the more NPSH required, since eye area is reduced. But a large shaft may be required to produce adequate rigidity for successful, trouble-free operation under severely fluctuating operating conditions. Also, the larger the impeller eye area, the lower the NPSH requirements, yet certain physical relationships of dimensions must be retained for a successful, commercially produced design.

Design Limits

Increased eye area in the first-stage impeller frequently is attained through the use of a double-suction first impeller, although such construction requires that the shaft span be increased considerably. This increase reduces shaft rigidity in the order of the fourth power of the increased length. Amplitude of vibration during periods of transient operation increases and danger of seizure is greater. Therefore, while this double-suction first-stage design may have hydraulically increased the NPSH capabilities of a given high pressure boiler feed pump it has reduced the shaft rigidity to a point where reliability is reduced, and successful operation during severe transients may not be possible. These over-all limits often restrict the pump designer in his efforts to meet unusually low NPSH requirements.

Capacity and Efficiency

Normally, the rated capacity of a centrifugal pump is relatively close to the point of maximum efficiency and the Suction Specific Speed at this rated capacity is reasonably close to the design Suction Specific Speed. Thus, in determining adequate suction conditions, it generally is permissible to use the rated capacity in conjunction with a reasonable value of Suction Specific Speed for the type of pump in question. This, however, is not entirely true for a multistage boiler feed pump for the simple reason that, where necessary, the first-stage impeller need not have its maximum efficiency at the same capacity as the remaining stages. Instead, the first-stage impeller can be selected for a capacity much in excess of the pump rated capacity, with the result that the operating Suction Specific Speed at the rated capacity can be increased ap-



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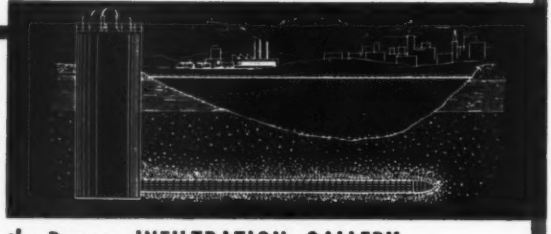

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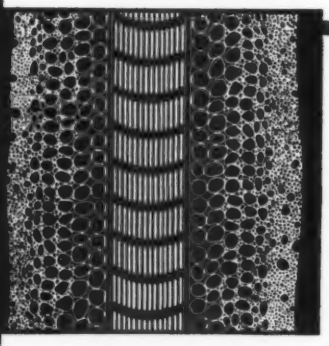

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precisably and the NPSH requirements can be reduced considerably.

Example

Such a solution is not an unmixed blessing as it results in a slight reduction in efficiency. Let us assume that we are dealing with an 8-stage, 3575-rpm pump rated at 1200 gpm and with a normal efficiency of 76 percent. With an S value of 8000, the required NPSH will be 39.5 feet. If we select a first-stage impeller that has its best efficiency at 1600 gpm, and if the S value at that capacity remains 8000, the required NPSH at 1600 gpm is 47 feet and becomes 33 feet at 1200 gpm, a reduction of 6.5 feet or 14 percent under normal design. However, at the capacity of 1200 gpm, this special first-stage impeller will have an efficiency of only 73 percent and in combination with the other 7 stages (which have an efficiency of 76 percent) the pump efficiency will have been reduced to 75.6 percent. This reduction in efficiency is a rather slight penalty when compared with the reduction in required NPSH thus obtained.

Variation with Capacity

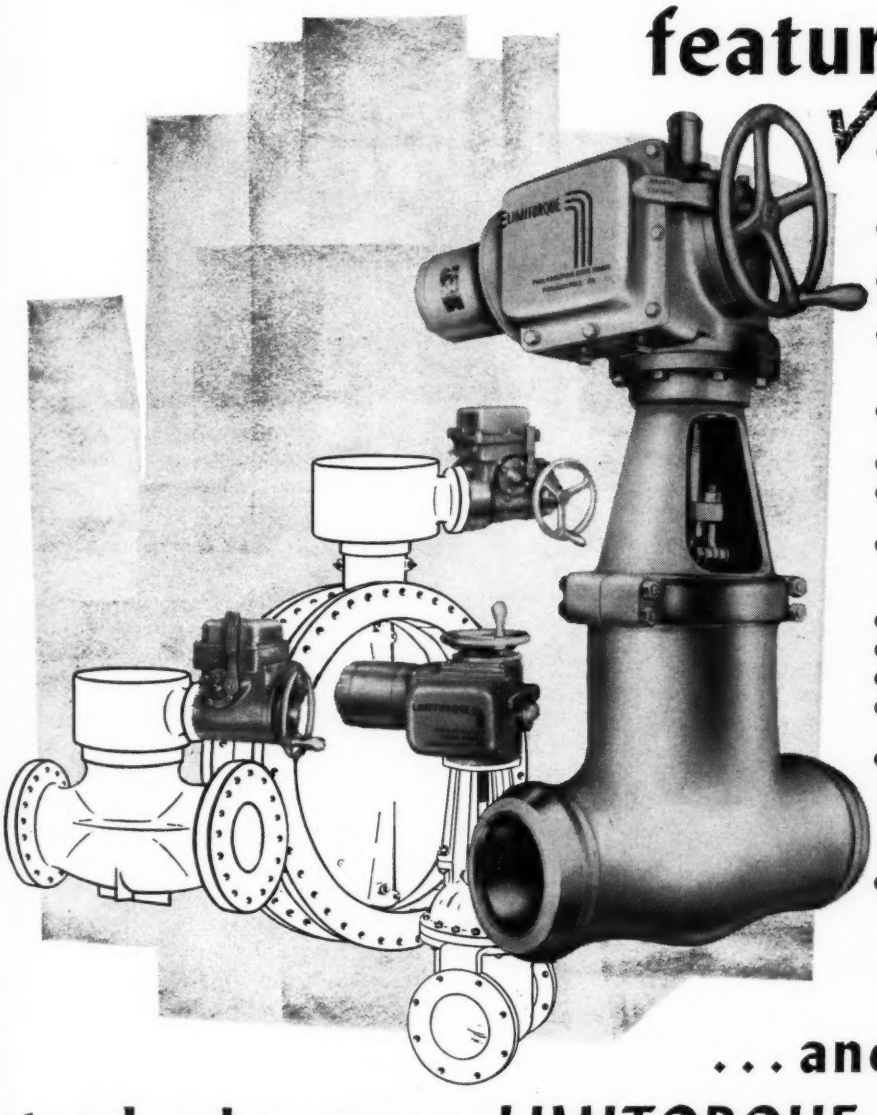
It will be noted that the particular first-stage impeller design required 47 feet of NPSH at 1600 gpm (its point of best efficiency) and only 33 feet at 1200 gpm. This variation of NPSH required with capacity at constant speed is shown percentage-wise in Fig. 5. This is a qualitative curve, and it must be used with discretion, since the rate of change shown may vary slightly between manufacturers and even between various designs produced by one manufacturer. Therefore, considerable judgment must be exercised in its use — especially where operation far from the point of best efficiency is contemplated.

Very Large Flow

A further control over required NPSH is available to the consulting engineer where very large flows are involved. Since NPSH required increases as the square root of capacity, half-capacity pumps will reduce required NPSH. For total flows less than about 2000 gpm, the attendant reduction in pump efficiency will add considerably to operating costs and offset any gain realized through NPSH improvement. For example, a 2000-gpm, 3575-rpm pump having an S value of 8000 will require 49.5-feet NPSH. If this total flow of 2000 gpm is split between two, 1000-gpm pumps, the required NPSH is reduced to 34.5 feet. Even at this relatively large total flow, however, there probably will be at least one point loss in pump efficiency.

With these data, therefore, the consulting engineer can approximate the NPSH that will be required. He can do his preliminary layout work with more certainty. ▲▲

Check these features



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News for the Consultant

Industry Air Conditions For Employee Comfort

A definite trend has developed toward air conditioning of U.S. industrial plants for increased employee comfort and efficiency as distinguished from air conditioning for product quality control, according to a survey conducted by The Trane Company through 19 of its 90 field sales offices.

Leading consulting engineers and architects in 19 areas of the nation were asked such questions as: "What proportion of U.S. factories do you estimate will be air conditioned by 1960? Please split your predictions between new construction and the addition of air conditioning to existing buildings." Representative estimates, based on the engineer's or architect's own area, are shown in the table below.

	1960		1970		1980	
	New	Old	New	Old	New	Old
Dallas	75%	50%	90%	90%	Above 95% in both	
Houston	50-75% in both types		All present facilities not abandoned by 1970 to be conditioned.			
Detroit	7%	3%	21%	9%	60%	30%
St. Louis			25%	10%	70%	20%
Cleveland	7%	4%	20%	15%	35%	25%
For both new and existing factories manufacturing precision and technical equipment: 1960, 25%; 1970, 40%; 1980, 75%.						
New Orleans	50%	50%	75%	75%	100%	100%
Atlanta	40%	10%	80%	50%	95%	80%
San Francisco	3%	6%	12%	20%	25%	30%
Chicago: 3% by 1960, 15% by 1970, 35% by 1980, 90 percent of those figures in new construction.						

Factors affecting increased use of air conditioning in the various sections of the country were outlined by the men queried as:

"Public demands and union demands will pressure building owners to provide air conditioned spaces," Sam Sirman, consulting engineer, Dallas, Texas.

"Unions are very active in the program in the textile industry and are insisting on an 80 F effective temperature; in the textile field it is hard to divorce comfort from process cooling, but the comfort requirement is becoming an important factor," P. L. Davidson, consulting engineer, Philadelphia and Greensboro, N. C.

"Air conditioning of factories in this area has not been purely for employee comfort but for the increased production obtained. . . In the Houston area air conditioning is as much a part of life as heating is in the colder areas," Bernard Johnson, of Bernard Johnson and Associates, Houston, Texas.

"The air conditioning of factories in this area is primarily for increased production and efficiency which results in profits to the owner. The fact that conditions for employee comfort are maintained is coincidental," Dale S. Cooper, of Dale S. Cooper and Associates, Houston, Texas.

In Detroit, Giffels and Vallet, architects and engineers, have been retained for a number of industrial installations air conditioned by Trane equipment. These include a Detroit machine shop conditioned for employee comfort and Bendix Aviation installations in Detroit and Baltimore making radar, radio, and computing devices.

Basic reason for industrial air conditioning in New York is competition for help. This requires air conditioning for offices and technical help, but air conditioning in manufacturing spaces solely for human comfort appears to be in the future.

In Los Angeles, many factories are already air conditioned. Trend is snow-balling as companies compete for personnel in critical labor market. Harold Cross, vice president of the Union Bank, recommends to bank's customers that they consider air conditioning to cut down turnover in personnel.

Costs on First Section of Turnpike 18 Percent Under Estimate

With four months to go before the originally estimated date for initial operation, most of the contracts have been let for the first section of the Florida State Turnpike and the entire length of the section is under construction; appraisals have been completed on 90 percent of the necessary land purchases, and purchase agreements have been entered into for property representing 82 percent of the originally estimated right-of-way costs. This 110 mile long section runs from just north of Miami to Fort Pierce and was planned as part of a Turnpike to run up as far as Jacksonville, a total over-all distance of 386 miles. It was decided to build this section first because of the great need and because it was realized that it would be the most profitable part of the full length road.

KAWNEER METAL WALL *engineered, manufactured and installed by Kawneer*

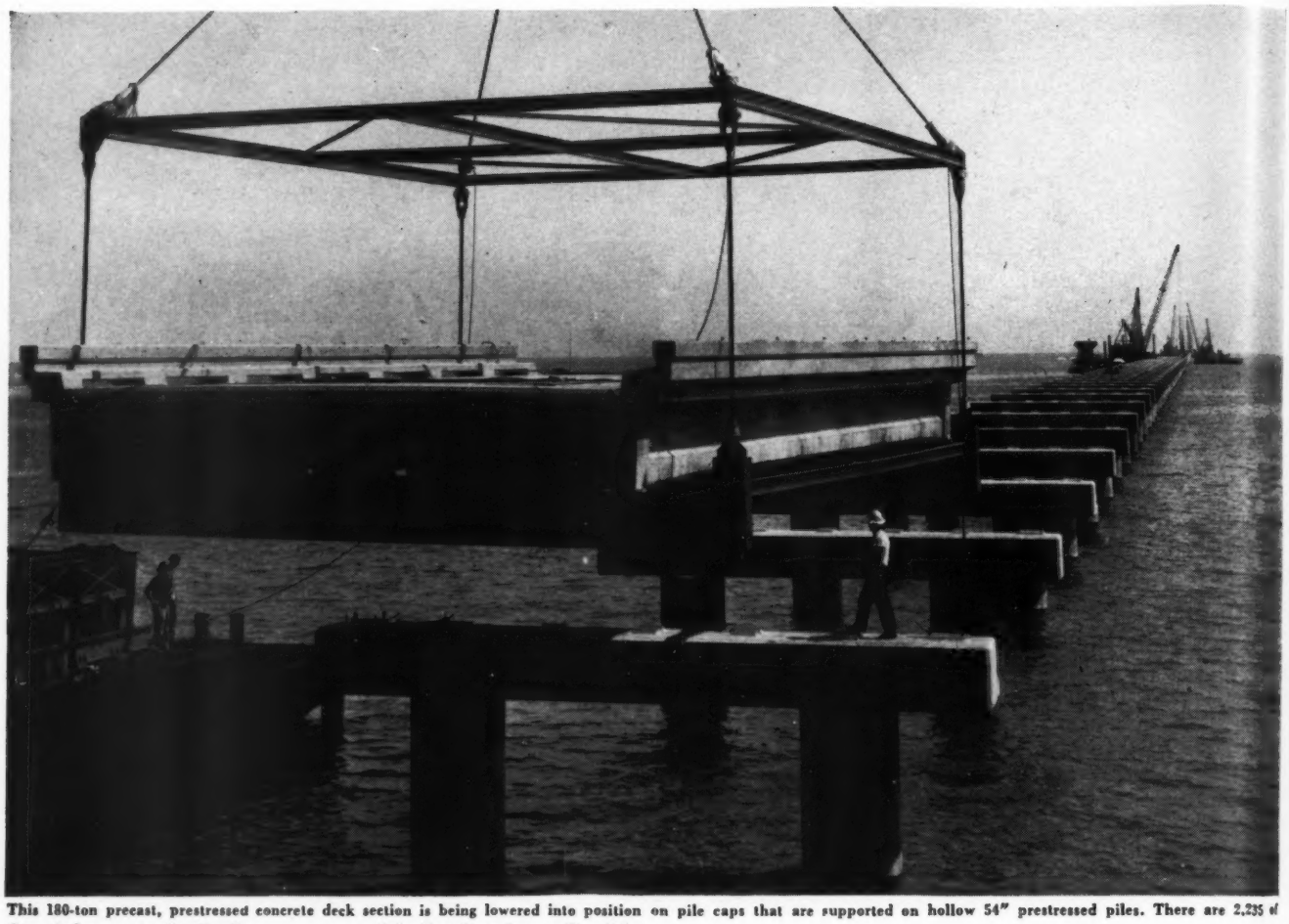
Other Kawneer metal wall jobs:

Tishman Buildings, *Los Angeles*
Equitable Life Building, *San Francisco*
Insurance Exchange Building *Oakland*
Imperial Oil Co., *Sarnia, Ontario*
Newark Center Building, *Newark*
Kaiser Aluminum, *Ravenswood, W. Va.*

From engineering through installation, Kawneer takes the complete responsibility for every metal wall contract. Years of creative engineering and production in the field of architectural metals has culminated in a new service for architects and contractors. This Mutual Benefit Building is an example of Kawneer's ability to combine many integrated skills into one department to service the contractor's needs. This department consisting of sales engineers, construction engineers, production men and installers, is another example of how Kawneer can gear itself to the needs of its customers. For complete information, please write: METAL WALL DEPARTMENT, Kawneer Company, Niles, Michigan.

Write for folder describing Kawneer services and metal wall jobs.

50TH ANNIVERSARY
Kawneer
General Offices
NILES, MICHIGAN
ARCHITECTURAL PRODUCTS DIVISION
1906–1956



This 180-ton precast, prestressed concrete deck section is being lowered into position on pile caps that are supported on hollow 54" prestressed piles. There are 2,235 of these deck spans on the 24 mile causeway across Lake Pontchartrain near New Orleans.

Why They Used Plastiment in the World's Longest Highway Bridge...

Efficient single unit beam-and-deck design and economical mass production are outstanding features of this 24 mile causeway across Lake Pontchartrain. Each day eight 56 foot deck-spans are cast in a single bed containing pretensioned wires.

Plastiment Concrete Densifier is being used for these reasons:

UNIFORM HIGH QUALITY YEAR AROUND—During cooler weather the minimum quantity of Plastiment is used for highest structural quality. More Plastiment is added in the hot summer to keep water content and setting time of concrete constant. Cracking and crazing are entirely eliminated.

HIGH EARLY STRENGTH FOR PRESTRESSING — Initial retardation allows time for placement and consolidation of the entire unit (89 cubic yards) even in the hottest weather. After this retardation, Plastiment concrete gains strength rapidly. Steam curing for 15 hours accelerates this gain. At three days, strength averages well above 4000 psi.

ECONOMY—An economical 6½ bag concrete mix, with varying proportions of Plastiment, results in uniform high structural quality well above specifications. Ease of placement and compaction, a characteristic of low slump Plastiment concrete, reduces placing costs.

Engineers: Palmer and Baker, Inc.
Mobile, Alabama

Contractor: Louisiana Bridge Company — A joint venture:
Brown & Root, Inc. — Houston, Texas
T. L. James Co., Inc. — Ruston, Louisiana

Write today for information on producing uniform concrete at all temperatures.

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SIKA Chemical Corporation, Passaic, New Jersey

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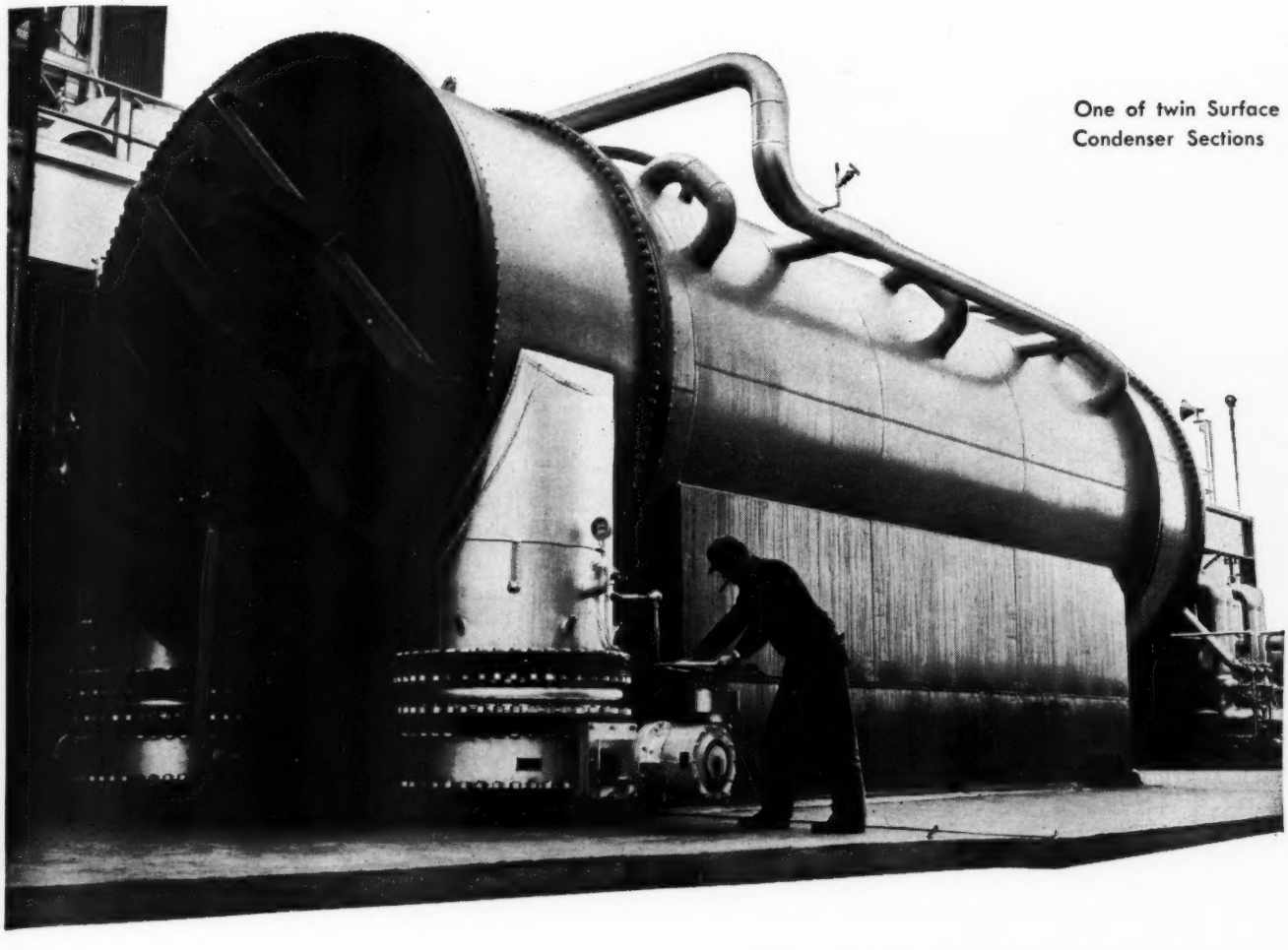


One of twin Surface Condenser Sections

Lummus Equipment Serves 110,000 KW Turbine For Texas Power and Light Company

Approximately 1 year ago, Lummus completed the installation of a 34,000 lb. per hr. evaporator, a 90,000 sq. ft. surface condenser and five feed water heaters, to serve a 110,000 KW turbine generator at the Collin Steam Electric Station of the Texas Power and Light Company.

The evaporator, designed by Lummus, is a high purity type which produces vapor of 1 ppm max. total solids purity, with a shell concentration of 3,000 ppm. It was furnished complete with a Lummus reflux condenser for producing condensate to be used on the bubble tray.

The Lummus-designed surface condenser is in two sections, joined by a common tee piece which connects to the turbine exhaust. The condenser is of the deaerating type producing an oxygen guarantee of 0.01 cc per liter.

The following Lummus feedwater heaters were furnished:

Item	Operating Pressure	Eff. Sq. Ft. Surface
Crossover Heater (Multilok)	2600#	6,745 sq. ft.
High Pressure Heater (Multilok)	2600#	6,490 sq. ft.
Intermediate High Pressure Heater	400#	2,850 sq. ft.
Intermediate Low Pressure Heater	400#	3,165 sq. ft.
Low Pressure Heater	400#	4,610 sq. ft.

Lummus heat transfer equipment provides long and trouble-free service in power generation.

THE LUMMUS COMPANY, Heat Exchanger Division, 385 Madison Avenue, New York 17, N. Y.
Atlanta • Boston • Chicago • Cincinnati
Cleveland • Dallas • Denver • Detroit • East Chicago (Indiana) • Houston • Kalamazoo
Kansas City • Los Angeles • Minneapolis
Nashville • New Orleans • Newton (Iowa)
Niskayuna (New York) • Omaha • Pittsburgh
Salt Lake City • San Francisco • Springfield (Mass.) • Syracuse • Toledo • Wayne (Pa.)
Athens • Buenos Aires • Caracas • The Hague
Lima • London • Mexico City • Montreal • Paris
Rome • San Juan

Steam Surface Condensers • Evaporators • Extraction Bleeder Heaters • Steam Jet Air Ejectors • Steam Jet Refrigeration • Barometric Condensers • Heat Exchangers for Process and Industrial Use • Process Condensers • Pipe Line Coolers

Fabricated Piping Division Plant at East Chicago, Ind.

LUMMUS

HEAT EXCHANGER DIVISION

The engineers estimate that, with normal weather conditions, the opening date of January 1, 1957 will be met and the actual construction cost of the project will show a saving of approximately $8.4 million, or 18 percent of the originally estimated $45.9 million.

One of the most difficult figures to estimate, particularly where a Turnpike is constructed through built-up areas, is the cost of right-of-way. On nearly every other Turnpike these costs have been appreciably higher than the original estimates. On one of the larger Turnpikes, right-of-way costs are running 220 percent of the preliminary figures. On the Florida Turnpike, these costs are estimated officially to be no higher than those contained in the Official Statement. By the time right-of-way costs are finalized, the right-of-way costs on the extra section (not figured in original plans) may raise the total by about $1.5 million on the over-all job.

Engineers' preliminary estimates show the earnings outlook for the entire Turnpike as more favorable than any other of the major Turnpikes now under construction. It is interesting to note that revenues expected to be derived from heavy trucks represent only 8.6 percent of toll revenues, a percentage much lower than for any other big toll project. In Coverdale & Colpitts' traffic report made in 1953, covering the first section of the Turnpike, they estimated a 14 percent traffic growth over the two years 1954-55. Actual counts made by automatic recorders showed a growth well above 14 percent.

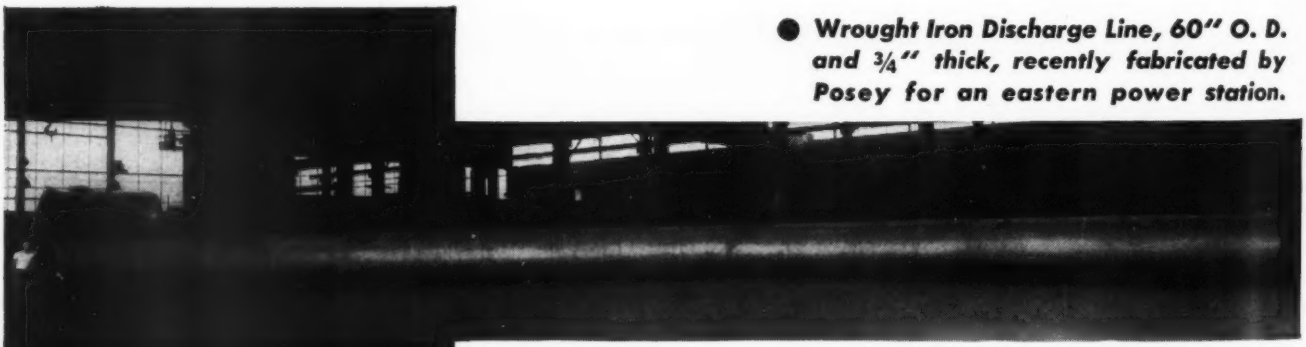
It is now planned to proceed with the second section, from Fort Pierce to Jacksonville, at an estimated cost of $185 million. Consulting engineers are Howard, Needles, Tammen & Bergendoff.

Insurance Data Available From Consulting Engineers Council

The article "Errors and Omissions Insurance for Consulting Engineers" in the August issue of CONSULTING ENGINEER, p 60, asked that all engineers interested in sample policies, rates, and application forms, or other information to write to The New York Association of Consulting Engineers. The Association has received so many inquiries that it has asked the newly-formed Consulting Engineers Council to handle them. President John K. M. Pryke is appointing a special committee for the purpose. To secure the data on errors and omissions insurance, write to Consulting Engineers Council, 220 E. 42nd St., New York, N. Y.

Committee of Fifteen Recommends New York for Engineering Center

The Special Task Committee of Fifteen appointed to make recommendations with regard to the site of the Engineering Societies Center has reported to the



● *Wrought Iron Discharge Line, 60" O. D. and ¾" thick, recently fabricated by Posey for an eastern power station.*

SEE POSEY

For Large O. D. WROUGHT IRON PIPE

For Sewage Outfall Lines, Water Intake Lines and Other Specialized Requirements

You can depend on Posey to meet your requirements in large O. D. wrought iron pipe . . . and you can depend on Posey to turn out your job economically and on time.

● *Posey Wrought Iron Pipe is fabricated from plates conforming with ASTM Specifications, Class A 42-52 T.*

● *Posey specializes in large O. D. Pipe and Pilings of wrought iron, carbon steel, low and high alloy steel and alloy clad steel.*

ELEVATED TANKS • HORIZONTAL TANKS • STACKS
PRESSURE VESSELS • DIGESTERS
CARBON STEEL AND ALLOY STEEL PLATE FABRICATION

POSEY IRON WORKS, INC.

Steel Plate Division Lancaster, Penna.
New York Office: Graybar Bldg. Established Since 1910

Gold Bond "FIREFIGHTER" Roof Deck protects every roof on this school ...barrelled and flat!

James F. Byrnes High School, Duncan, South Carolina.
Architect: Lockwood Greene, Spartanburg, S. C.; *General Contractor:* Fiske-Carter Construction Company, Spartanburg; *Roof Deck Contractor:* Bonitz Insulation Company of South Carolina, Columbia, S. C.

THE 70,000 square feet of roof area on the James F. Byrnes High School is protected from fire with economical Gold Bond "Firefighter" Roof Deck. This also includes the walkways which extend from building to building. Wherever you go, you are protected by a roof deck that is naturally fireproof. The poured gypsum concrete deck *can't* burn!

Econacoustic Formboard, which was used on this school, insulates and sound-conditions the classrooms, gym and auditorium. And there are other Gold Bond Formboards available that can be varied according to specifications: Gypsum Formboard specially treated to resist mildew; Insulation Formboard that resists fungus and termites; Asbestos-Cement Formboard for additional fire-resistance.

Gold Bond "Firefighter" Roof Decks are adaptable to the barrelled and flat roofs on the Byrnes High School as well as being a practical covering for pitched roof designs. *Up to 30,000 sq. ft. may be poured in just one day...* and full load roof capacity is possible within an hour! Low dead load permits lighter supporting structures to be specified and saves on actual construction costs.

See how Gold Bond "Firefighter" Roof Deck can add safety and economy to your building designs. Send in the coupon below for full details. National Gypsum Company, Buffalo 2, New York.

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"FIREFIGHTER" GYPSUM ROOF DECK

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NATIONAL GYPSUM COMPANY, Dept. CE-96

Gentlemen: Send me Technical Bulletin No. 589 with complete details on "Firefighter" Roof Decks.

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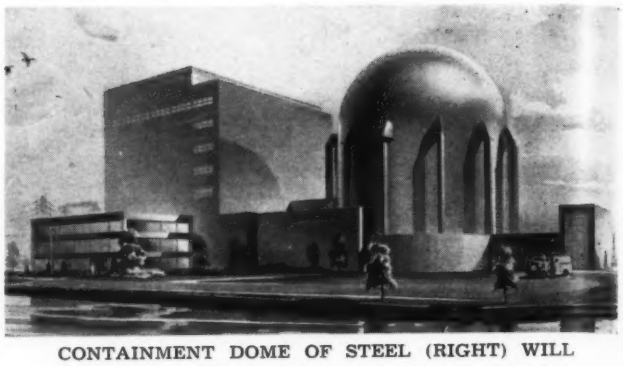
presidents of the four Founder Societies and the American Institute of Chemical Engineers. Next step is presentation to governing bodies of each society.

Recommendations include location of the Center in New York City, at the 39-40th Street site. If rebuilding in this area proves impractical, a mid-town New York location is suggested.

Under the recommendations, United Engineering Trustees, Inc. would be authorized to take legal action to include AIChE in the corporation; accept the offer of the Kelly Committee; place contributions in UET Capital Fund Assets; raise and accept contributions; employ architects, engineers, and attorneys, and let contracts for reconstruction of the present building or construction of new facilities; pay costs out of the Capital Fund Assets; and operate and maintain the new Center.

The Committee also urged that the plans make ample provision for future expansion of the five societies and that the completed facilities take into account needs of the entire engineering profession.



CONTAINMENT DOME OF STEEL (RIGHT) WILL ENCLOSE REACTOR. POWER STATION IS AT LEFT.

Atomic Power Reactor Named for Enrico Fermi

At inaugural ceremonies for Power Reactor Development Company's atomic power plant near Monroe, Mich., the plant was named for Enrico Fermi, the physicist under whose direction the first atomic "pile" was designed and constructed at the University of Chicago.

Preparation of the plant site has been going on for four months; architectural and construction engineers have been retained (Commonwealth Associates and United Engineers & Constructors); the 150,000 kw steam turbine generator to be used for the conventional part of the plant is on order from Allis-Chalmers; and full-scale reactor parts are ordered and under construction.

The reactor parts include the stainless steel vessel that will enclose the reactor core; heavy shield, control, and fuel handling parts; and a centrifugal pump powered by a 1000 hp motor, capable of driving molten sodium at a rate of 11,000 gpm.

BISON

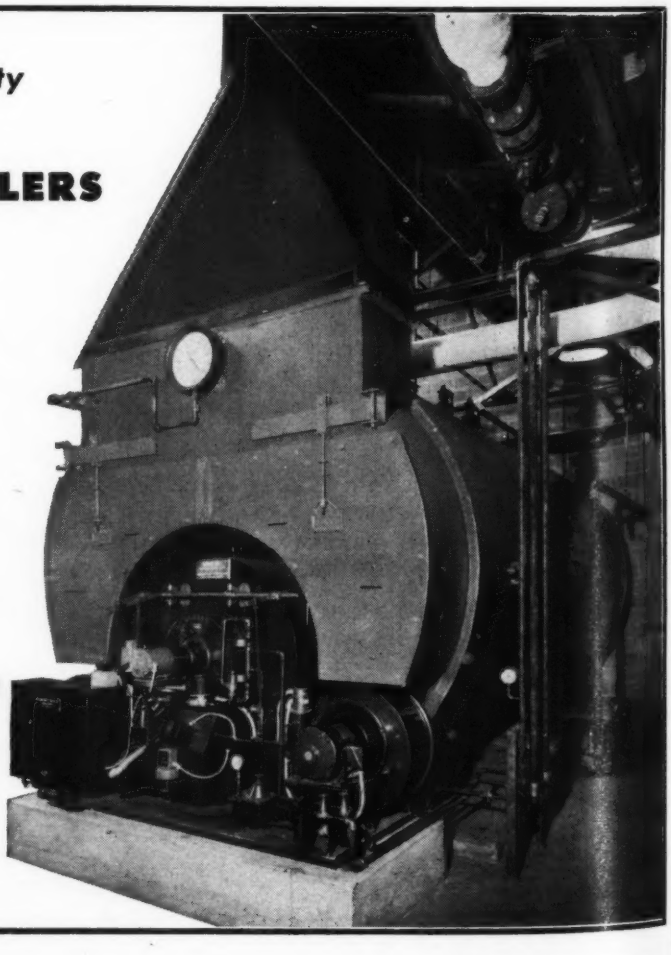
Dependable quality since 1863 . . . . .

POWER BOILERS

Throughout 93 years, Farrar & Trefts has been a leader in boiler design and construction. Today, as in yesteryear, F & T offers dependable, efficient, modern power boilers to satisfy the ever-increasing demands of institutional, apartment, office and industrial buildings. Under the same BISON brand, F & T also furnishes low-pressure boilers for heating purposes.

Proper selection of a boiler for the continuous delivery of required heat and power is a precise project, demanding the systematic approach of engineers long trained in this work. Engineers at F & T have this background of service and they welcome opportunities to evaluate the needs of boiler users.

Standard F & T Super Scot Power Boiler (150 lb. design pressure) with "Indiana Pack" burner at Mastic Asphalt Corp., South Bend, Ind. Furnished by Page Associates of Chicago. The Austin Co. were the Engineers and Contractors.



FARRAR & TREFTS DIVISION
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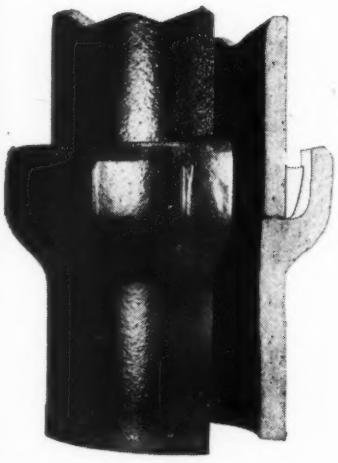
AMVIT* JOINTED CLAY PIPE gains wide acceptance, more than 60 major installations completed in 1955



Never before has a new product gained such wide acceptance and usage in such a short period of time.

In the first year since Amvit Jointed Clay Pipe was introduced more than 60 major installations have been completed with outstanding results. Such pioneer cities as Dayton, Ohio, Camden, New Jersey, Ostego, Michigan, Victor, New York, have installed their second and third Amvit Jointed sanitary lines.

Prevents Infiltration

Field tests from these installations show that ground water infiltration can be controlled and prevented—thus reducing pumping and treatment plant costs. Amvit is a compression type joint on the ball and socket principle. Nothing can enter the line after it is complete.

Quick Installation Saves Labor

Since no other material such as caulking, joint compound, hot-pots or ladles are needed to make the Amvit Joint, installation is quick and easy. The joint is on the pipe delivered to the job ready to use. Savings with Amvit Jointed Clay Pipe mean *lower cost of pipe in place* when the line must meet a rigid test.

Amvit Jointed Clay Pipe, in sizes 4" through 24", together with all fittings is available for immediate delivery in the Northeast and Central States.

For more information, write or call American Vitrified Products Company, National City Bank Building, Cleveland, Ohio, or our office nearest you.

Indiana

New Jersey

Michigan

Wisconsin

Illinois

*T M. Registered Patents Pending

SINCE 1900

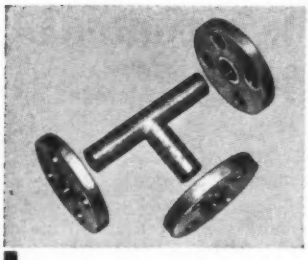
AMERICAN

American Vitrified Products Company

CLEVELAND, OHIO

MANUFACTURERS of: Clay pipe, flue liners, clay liner plates and concrete pipe.

Plants Across the Nation...Brazil, Indiana • Chicago, Illinois • Cleveland, Ohio • Crawfordsville, Indiana • Detroit, Michigan • East Liverpool, Ohio Fenton, Michigan • Grand Ledge, Michigan • Lisbon, Ohio • Los Angeles, California • Milwaukee, Wisconsin • South Bend, Indiana • Uhrichsville, Ohio



Speedline Tee and Speedline Insert Flanges before assembly.

HERE'S HOW...

Speedline fittings can be converted to flanged fittings—on the job. The "tangential" feature (additional straight section) makes the difference.

Speedline Tee with Flanges expanded on all outlets.

Write for YOUR Speedline Fittings Catalog *Today*.

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Speedline® STAINLESS STEEL FITTINGS

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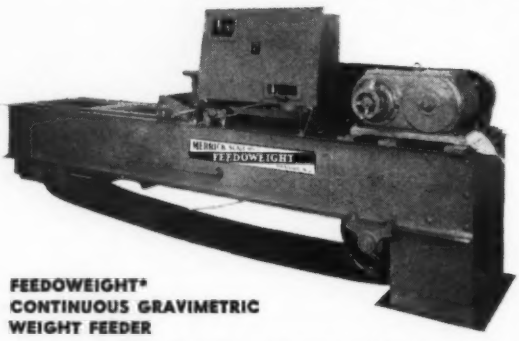
In-Transit Weighing by MERRICK!



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CONTINUOUS GRAVIMETRIC
WEIGHT FEEDER

Automatic continuous constant weight feeder. Ideal for blending, proportioning and feeding of granular materials to process by weight.

Extensively used for ball and rod mill feeding. Widely accepted as the proper medium to accurately blend basic cement components such as clinker, gypsum, etc. Ruggedly constructed for long-life, trouble-free operation.

*Reg. U. S. Pat. Off. Bulletin 253 on request

MERRICK SCALE MFG. CO.

PASSIAC NEW JERSEY

The conventional part of the plant will be owned and operated by Detroit Edison Company on steam produced by the atomic reactor. The plant will be test-operated at low power levels before full operating capacity is reached, sometime after 1960. When put on full load, it will supply electric power for about a quarter of a million people.

State Assns. Discuss Consulting Engineers Council

The twenty members of the Missouri Association of Consulting Engineers who attended the special meeting July 31 called to discuss payment of assessed dues for the newly formed Consulting Engineers Council voted unanimously to underwrite the MACE's apportionment of the Council budget for the remainder of the fiscal year contingent upon all other state groups accepting the apportionments.

However, several of the other states feel that the formula used to determine the State Association Assessments is not properly set-up. California has requested that there be another meeting of the Board of Directors to discuss this matter and see if some better and more equitable formula can be found. Minnesota agrees that a Directors Meeting is needed.

At the July meeting of the Board of Directors of the California Council of Civil Engineers and Land Surveyors, William A. White, executive secretary of the California Council, went on record as being opposed to the California Council applying for membership in CEC on the basis of his observations at the meeting in St. Louis, in December, that most of the engineers at the meeting were consultants to architects. He stated that unless and until the CEC takes in the civil engineer practitioners who can give a complete engineering service through the stake-out for construction, and includes the land surveyors who represents 38 percent of the membership of the California Council, his group might find itself giving financial support to programs not in its own best interest.

President Leo W. Ruth, Jr. promised to set up a special committee on organization and policy to consider this and other questions.

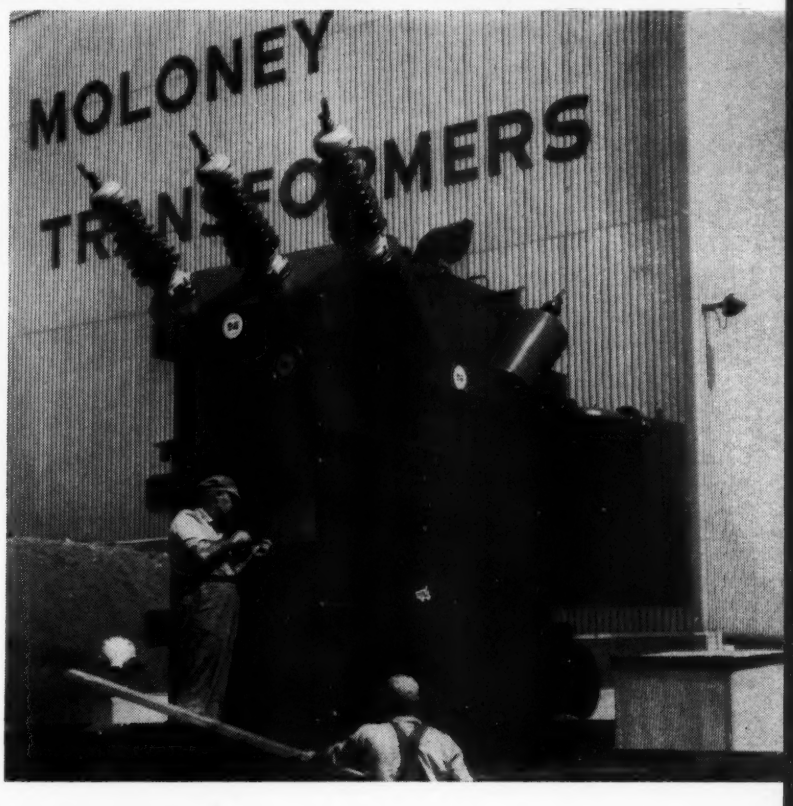
Engineers Protest Award of Contract by Bidding

The Washington Society of Professional Engineers has filed a protest with the town of Cosmopolis, Washington, against its call for sealed competitive bids for professional engineering services. The Town of Cosmopolis is seeking the services of an engineering firm to plan sanitary sewers and sewerage disposal facilities. The invitation also states that the successful bidder will be required to furnish a performance bond.

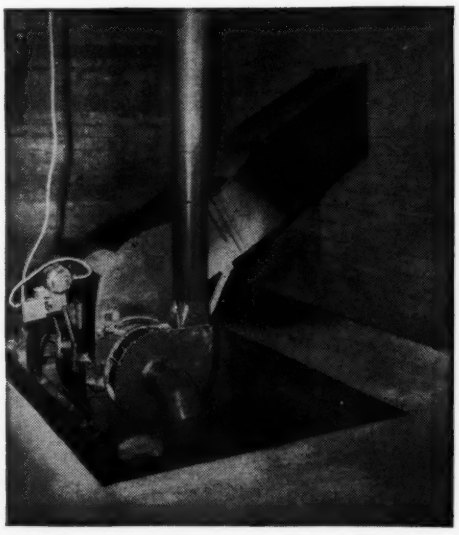
WSPE has requested the town to withdraw its invitation and, as an alternative, to negotiate contract terms with the firm considered to be most qualified to undertake the work. ▲▲

HOW USS "T-1" STEEL IMPROVES THESE PRODUCTS...

Lower-Cost Dirt. This mammoth coal stripping machine scoops out 2000 cu. yds. of overburden an hour, cuts the cost of stripping coal that lies under 50 to 80 ft. of overburden. Its 22-ft. wheel carries eight buckets, each 4 ft. wide, with lips of 2½-inch USS "T-1" Steel. USS "T-1" Steel has the strength and toughness to scrape through shale, rock, mud, and ram into ton-and-a-half boulders day in and day out. In addition, it is weldable in the field, costs less than other steels that could be used—and outlasts them. This wheel excavator was designed by United Electric Coal Companies, Chicago, for their own use.



Heavier Loads, More Production. Mack Welding Company, Duluth, Minnesota, has used USS "T-1" Steel to increase the durability and at the same time reduce the weight of its Orange Peel Type, Four Tine Pulpwood Grapples. With these new, lightweight grapples, crane operators can handle increased payloads with present cranes. As a result, production can be increased as much as 40 percent.



Shucks, hay fodder, corn cobs, and grains are extremely abrasive when sucked out of a hammermill at high speed. And the blades of the fan that does the sucking must be able to withstand the abrasion and must be weldable. Myers-Sherman Company, Streator, Illinois, manufacturers of industrial hammermills, now make these fan blades from USS "T-1" Steel and save $7 on fabrication of each fan. USS "T-1" Steel provides all the needed durability, as well as good weldability.

Moloney Saves A Ton. The size of everything had to be reduced on this new, smaller-than-ever portable transformer designed by Moloney Electric Company, St. Louis, Missouri. Over a ton of weight was saved in the tank alone by building it of ¼-inch USS "T-1" Steel instead of ⅜-inch carbon steel. The very high strength of this heat-treated alloy steel made possible this 25% saving in weight. The excellent weldability of USS "T-1" Steel was important, too, because this portable transformer is permanently welded to the bed of a semi-trailer. This particular unit was designed for Oklahoma Gas & Electric Corporation. Shell was fabricated by Nooter Corporation, St. Louis.

HOW IT CAN HELP YOU

USS "T-1" Steel, with its high minimum yield strength of 90,000 psi and its minimum tensile strength of 105,000 psi, can help you design or build lighter-weight equipment that will last longer. Its unusual toughness can help you design or build equipment capable of taking severe impact and abuse at sub-zero temperatures. Its excellent weldability can help you cut the cost of fabricating high strength parts, and to reduce repairs and maintenance expense.

Somewhere in your operation, versatile USS "T-1" Steel can help you. Write, wire, or phone United States Steel, Room 5413, Pittsburgh 30, Pa.

UNITED STATES STEEL CORPORATION, PITTSBURGH • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.

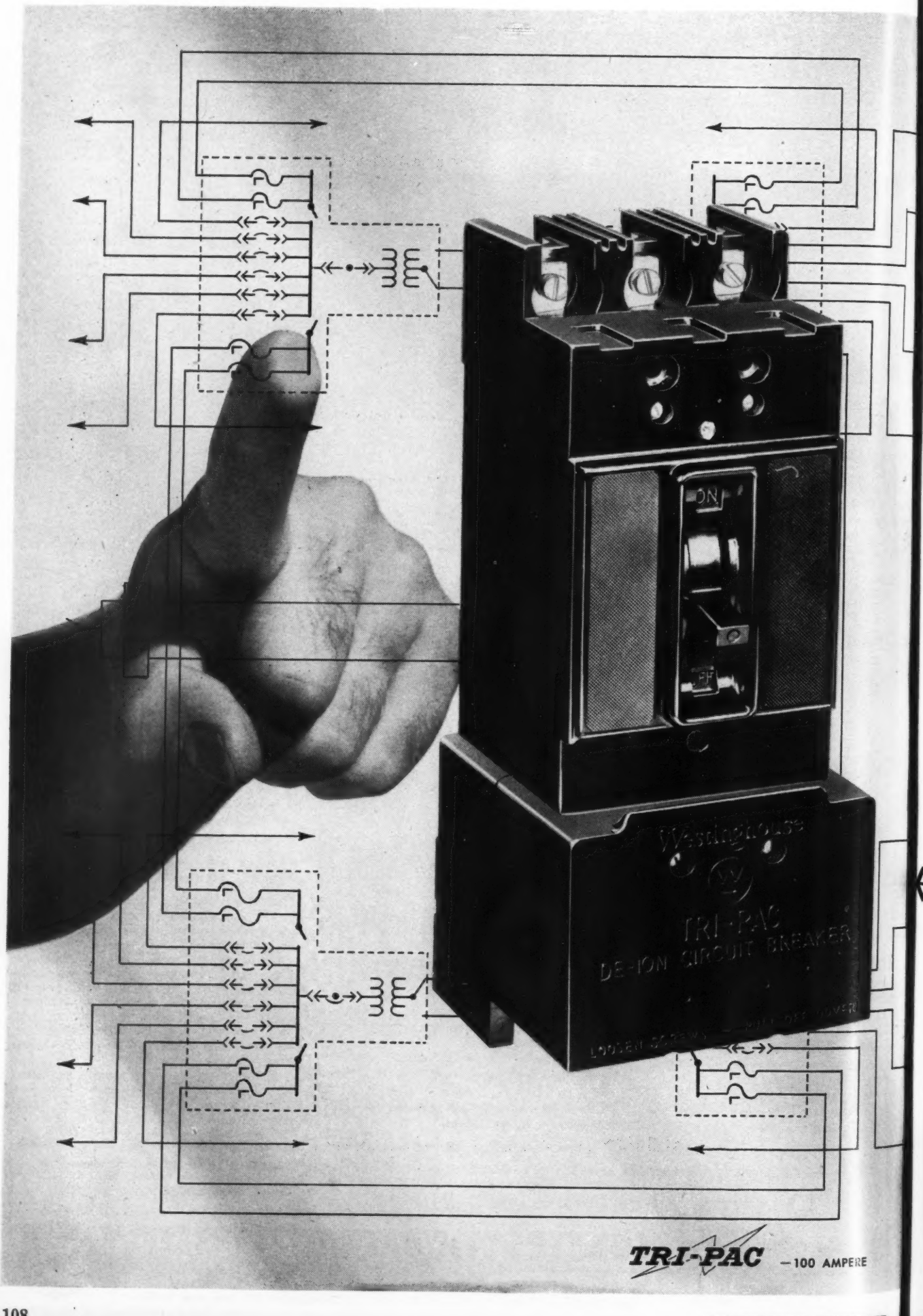
UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS, COAST-TO-COAST • UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS "T-1" CONSTRUCTIONAL ALLOY STEEL

See The United States Steel Hour. It's a full-hour TV program presented every other week by United States Steel. Consult your local newspaper for time and station.

USS

UNITED STATES STEEL



TRI-PAC —100 AMPERE

100,000 amps gets a new boss—the Westinghouse Tri-Pac breaker

The Westinghouse Tri-Pac breaker is the smallest protective device that can be used where 100,000 amps can be poured into faults. It combines the inherent advantages of both the molded case breaker and fusible current limiters to positively protect electrical circuits—throughout the range from overloads to fault currents that could build up to 100,000 amperes, if not stopped.

Co-ordinated triple circuit protection—thermal, magnetic, and current limiting—in one compact breaker. At much less cost than larger air circuit breakers of equivalent ratings and with more safety and convenience than switches combined with fusible elements. That's why Tri-Pac offers the most practical and economical solution to the constantly increasing interrupting requirements of network systems and those fed by large transformers.

The breaker trip portion of Tri-Pac handles overloads and moderate faults—eliminating fuse replacement headaches and costs. On higher currents, the current limiters in Tri-Pac trip faster, insuring the prompt protection required at those high currents. In Tri-Pac the current limiters and the breaker are co-ordinated so that the current limiter will trip at and above a point slightly under the interrupting capacity of the breaker. Below that point, the limiters remain undamaged, letting the breaker do the work.

Fault single phasing—a drawback of fuses—is averted by Tri-Pac breakers. The blowing of a current limiter actuates the breaker trip bar and all poles of the breaker open simultaneously. And when a high fault current is interrupted, indicating buttons on the current limiters clearly designate the troubled phase.

NETWORK SYSTEM PROTECTION

With today's increased use of network systems, the possibilities of 100,000-amp fault currents are not uncommon. New Tri-Pac breakers insure positive protection against all system current faults—large or small—at a new and greater economy.

HERE'S MORE INFORMATION ON TRI-PAC

A Westinghouse sales engineer can show you additional reasons why the new Tri-Pac breaker is your best buy for powerful circuit system protection. Call him today.

J-30215

WATCH WESTINGHOUSE!

COVER THE PRESIDENTIAL CAMPAIGN ON CBS TV AND RADIO!

Engineer—Editor

CONSULTING ENGINEER is enlarging its editorial staff. We need a young man with an engineering degree (preferably civil or electrical) who has had experience in report writing or writing for publication. Experience in a consulting engineer's office will be helpful. The position will be that of field editor in the East, working out of New York City, visiting offices of consulting engineers, and writing and editing articles. Please send full history, photograph, and indication of salary requirements.

Editor
CONSULTING ENGINEER
227 Wayne St., St. Joseph, Mich.

MEN IN ENGINEERING

Emil F. Vranich, Structural Engineer, has joined the firm of Robert J. Strass, Inc., Professional Engineers, as vice president. Carroll R. Maguire has been named an associate of the firm and LeRoy Bednarek has been appointed chief structural draftsman.

Frank H. Wark, Sr., has been made Director of Engineering of Wheeler Associates, Inc. Wark was formerly Chief Engineer of the St. Joseph Division of the Whirlpool Corp. Wheeler Associates recently added 5000 sq ft of office space and organized the new Department of Creative Design.

William Atlas, formerly chief engineer for Paul Weidlinger, has opened an office for the practice of structural engineering at 37 West 39th St., New York, N.Y.

Buchart Engineering Corp., York, Pa., has added Henry K. Owen to the staff in the capacity of consulting engineer for industrial planning.

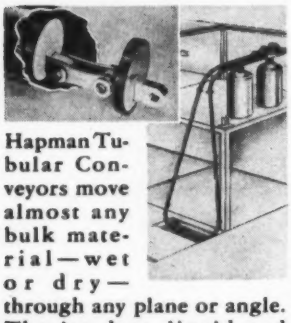
Michael Baker, Jr., Inc. has purchased the J. Murray Africa Co.

HERE'S HELP

THAT SOLVES TROUBLESOME BULK HANDLING PROBLEMS:

Hapman

Tubular and Pivoted Bucket Conveyors



Hapman Tubular Conveyors move almost any bulk material—wet or dry—through any plane or angle. They're dust, liquid and odor-tight. Investigate!

WRITE for Bulletin T-CE96.

Exclusive top loading device on Pivoted Bucket Carrier handles fragile materials gently. Many other unique advantages.

WRITE for Bulletin P-CE96.

Hapman CONVEYORS, INC.
DIVISION HAPMAN-DUTTON COMPANY
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In British Commonwealth & Europe: Fisher and Ludlow Ltd., Birmingham

Also builders of famous Dutton Boilers.

Handiest Locations in PITTSBURGH

Hotel Pittsburgher
PITTSBURGH, PA.
Diamond Street below Grant

Right in the heart of the Golden Triangle—Hotel Pittsburgher

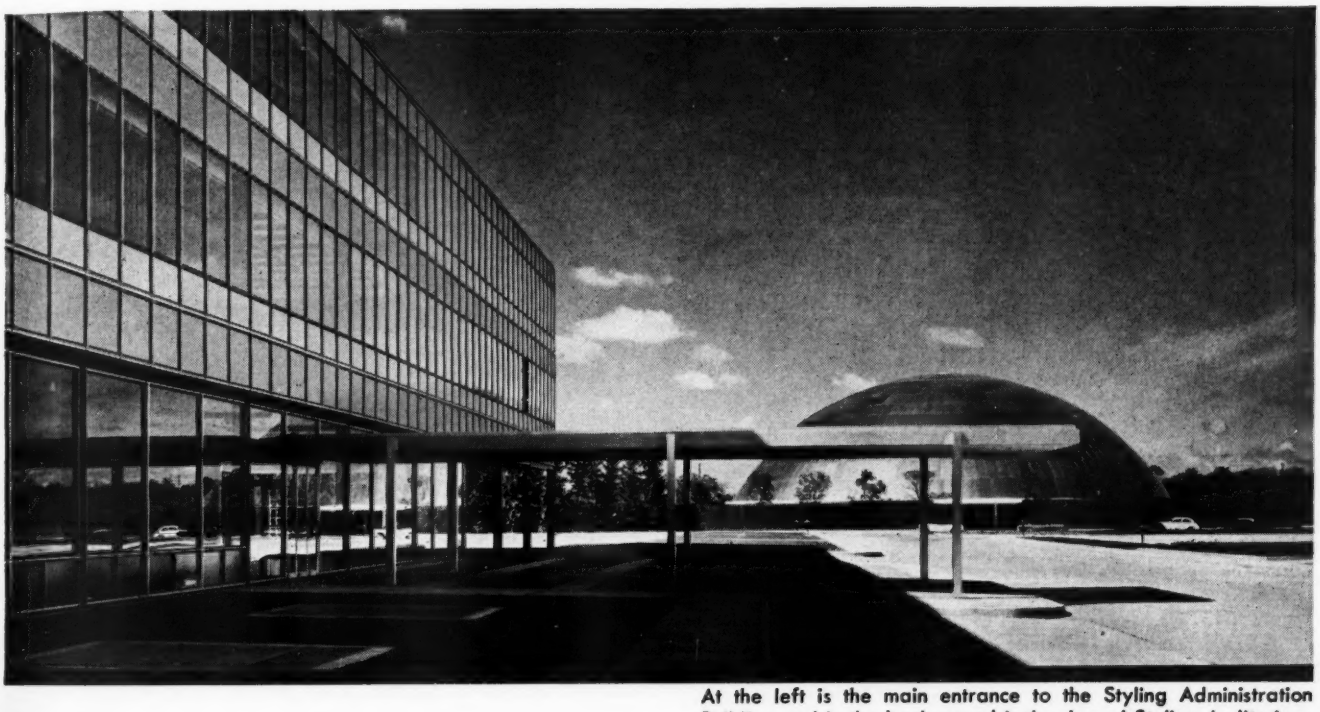
400 outside rooms with bath. Large-screen television and radio at no extra charge in every room. Air conditioning. Finest dining room. *ATlantic 1-6970*

Hotel Pittsburgher MOTEL

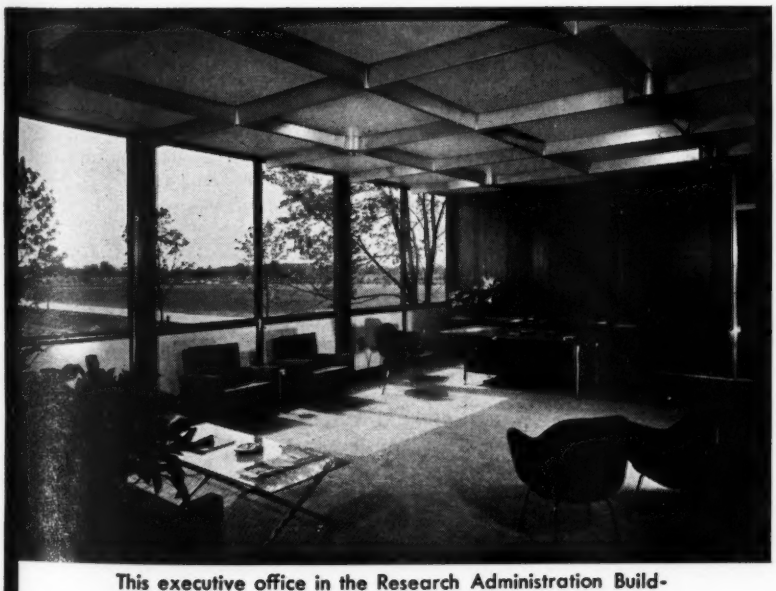
Opposite Greater Pittsburgh Airport on Airport Parkway west. 56 air-conditioned rooms with large-screen television at no extra charge. Tile bath. Private phone. Restaurant facilities. Courtesy car to and from airport. *AMherst 4-5152*

a Knott Hotel
JOSEPH F. DUDDY, GEN. MGR.

THERMOTANK'S *HIGH-VELOCITY* AIR CONDITIONING SELECTED BY FABULOUS GM TECHNICAL CENTER



At the left is the main entrance to the Styling Administration Building and in the background is the domed Styling Auditorium, two of the seven buildings air conditioned by Thermotank, Inc.



This executive office in the Research Administration Building shows a typical installation of Thermotank's custom-designed air diffusers with integrated sprinkler heads.

IN co-operation with General Motors' engineers, Eero Saarinen & Associates, architects, and Smith, Hinchman & Grylls, Inc., architect-engineers, Thermotank, Inc., helped design a new high-velocity, double-duct air conditioning system for seven of the buildings in the magnificent General Motors Technical Center. Using techniques developed through 30 years' experience in moving air at high speeds through tight spaces, Thermotank engineers provided a streamlined duct design with noiseless Thermo-Reg mixing boxes and high-velocity ejection ceiling diffusers, which incorporate sprinkler heads and are integrated with the ceiling acoustical treatment. Thermotank invites inquiries about further details of this advanced system of high-velocity, year-'round air conditioning.

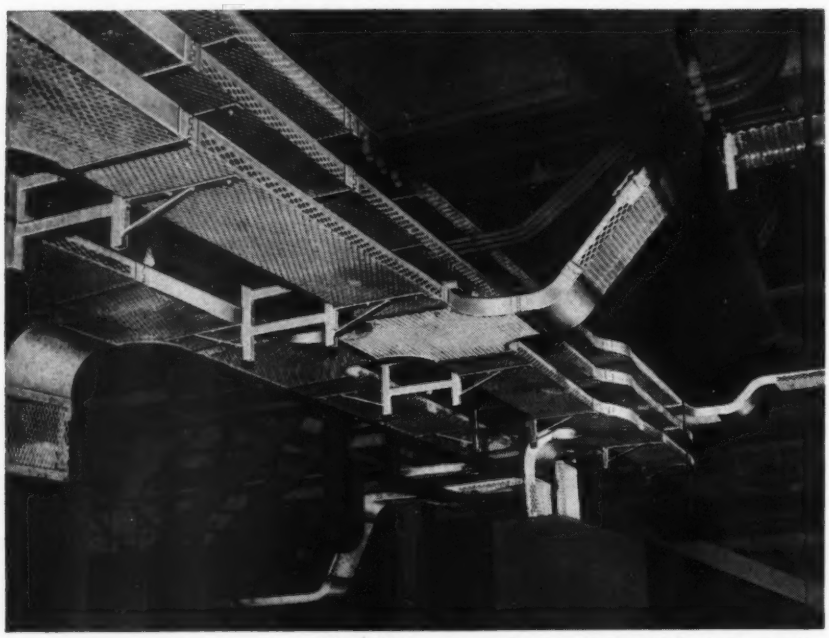
GENERAL MOTORS TECHNICAL CENTER

THERMOTANK INCORPORATED

Air Conditioning Engineers & Consultants • Air Conditioning Products

11191 LAPPIN AVENUE • DETROIT 34, MICHIGAN

P.G.&E. Uses Cope Cable Trough

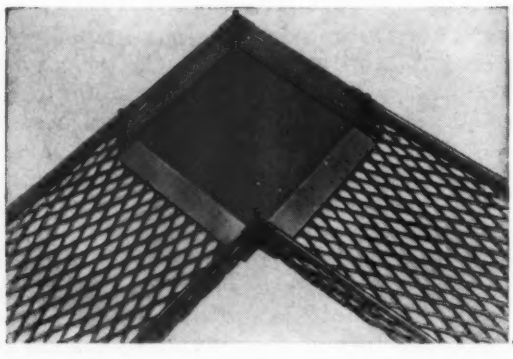


Humboldt Bay Steam Plant Pacific Gas & Electric Corporation
Engineers: Bechtel Corporation

Pacific Gas and Electric installed Cope cable trough for its latest installations in new generating stations. Efficient utilities everywhere are adopting Cope cable trough to eliminate costly and needless conduit.

Cope cable trough saves three ways:

- *Materials* are reduced by 75% on a lineal foot basis
- *Installation costs* are reduced because cable trough is so easy to install
- *Operating costs* are reduced because accessible cable is simple to inspect, repair or replace and additions are simply laid in existing trough.



New Cope 70,000 Series features unique flexibility in elbows— reduces the need for standard fittings.

Our engineers are ready to work with you. Write us today for full details on new 70,000 Series.

T. J. COPE, INC.
COLLEGEVILLE 6, PA.

Cope

TEE

DROP-OUT

CABLE SUPPORTING RISER ELBOW

TROUGH WITH BARRIER STRIPS AND COVER

of Huntingdon, Pa. The 135-year-old Africa Company will be operated as a division of the Baker firm with offices remaining in Huntingdon.

Three consulting engineers have been honored by the American Society of Civil Engineers by election to Honorary Membership. They are: George W. Burpee, senior partner in the firm of Coverdale & Colpitts; Maj. Gen. Thomas M. Robins (U.S.A., ret.) of Portland, Ore.; and Ole Singstad, of Singstad and Baillie.

S. D. Bechtel, president of Bechtel Corp., San Francisco, has been named to a three-year term on the Board of Trustees of the Committee for Economic Development.

W. T. Rogers, director of the Safety Department of Ebasco Services, Inc., has been appointed representative of the Electric Light and Power Group on the American Standards Association Safety Standards Board.

The president of Walter Kidde Nuclear Laboratories, Inc., W. E. Kelley, has been elected a director of Walter Kidde Constructors, Inc.

KELLEY

CALVA

Jose B. Calva, Director of the Minnesota Association of Consulting Engineers, and head of J. B. Calva and Co., has been elected a Fellow of the American Association for the Advancement of Science.

United Engineers & Constructors, Inc. has named Arthur C. Eckerman to the newly created post of Director of Personnel. Eckerman comes to United Engineers from Chicago where he was manager of personnel services for Pioneer Service & Engineering Co.

A new consulting engineering firm has been organized in Milan, Italy, to be known as Electroconsult. The firm will specialize in consulting services in the field of electric power. The Board of Directors consists of Dr. Ing. Piero Giustiniani, chairman; Comm. Rag. Camillo Ghiglione, director; and Dr. Ing. Antonio Rossi, director. It is managed by a committee of six members: Dr. Ing. Claudio Castellani, Dr. Ing. Dante Finzi, Prof. Ing. Mario Mainardis, Dr. Ing. Francesco Pennacchioni, Dr. Ing. Pietro Rossi, and Dr. Ing. Carlo Semenza.

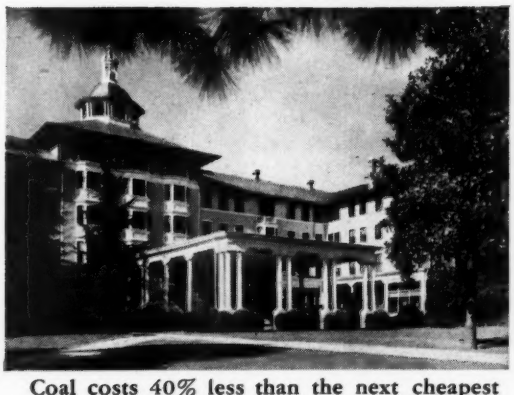
or lowest cost steam generation, *Gener- l Electric,* Louisville, Ky., burns coal e modern way.

At *American Cyanamid,* Bridgeville, Pennsylvania, power system modernization saves the firm $100,000 a year.

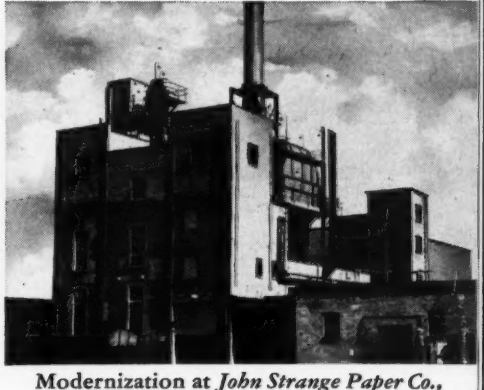
Burning coal the modern way at *Pennsylvania RR's* Juniata shops in Altoona saves $500,000 a year.

Each year more firms

arbide & Carbon, South Charleston, W. a., saves $470,000 a year in lower costs nd increased efficiency.



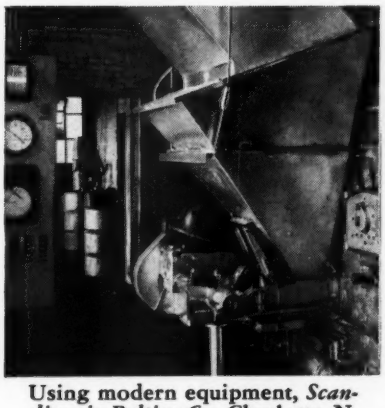
Coal costs 40% less than the next cheapest fuel at *Pinehurst, N. C.* resort . . . modernized plant 33% more efficient.



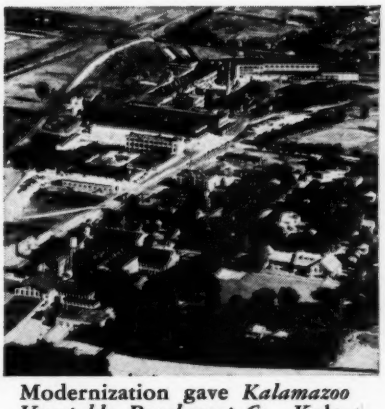
Modernization at *John Strange Paper Co.,* Menasha, Wis., reduced power costs and increased plant production 10%.

are burning coal the modern way

Modernization by *Clark quipment Co.,* Battle Creek, Mich., supplies power for xpanding production facil- ies, saves $7,500 annually.



Using modern equipment, *Scandinavia Belting Co.,* Charlotte, N. C., has increased steam capacity 150%, cut fuel costs 15% and reduced labor costs 70%.



Modernization gave *Kalamazoo Vegetable Parchment Co.,* Kalamazoo, Michigan, increased steam with lower fuel and operating costs.

Burning coal the modern way resulted in "peak efficiency and economy" for *Garlock Packing Co.,* Palmyra, New York.

for efficiency and economy

facts you should know about coal

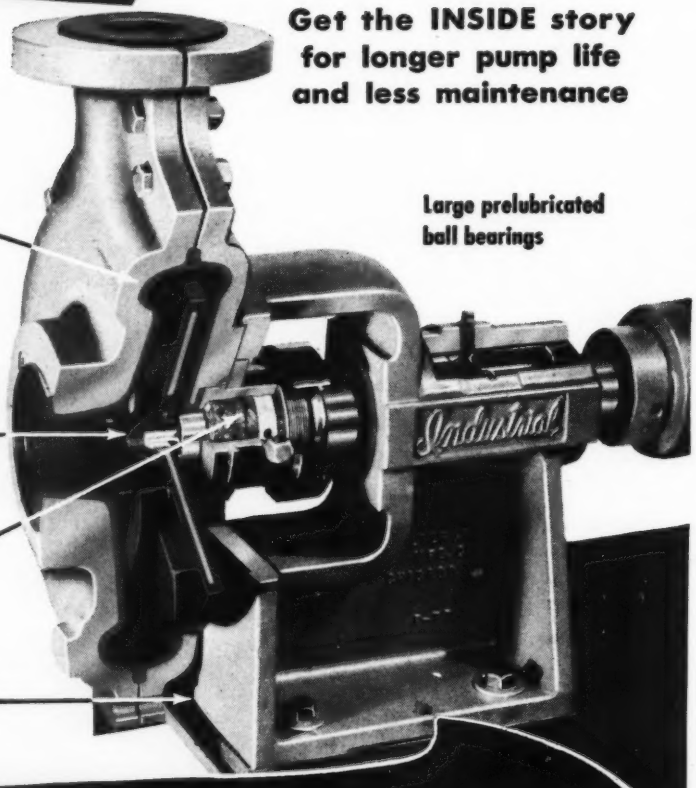
In most industrial areas, bituminous coal is the lowest-cost fuel available • Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar • Automatic coal and ash handling systems can cut your labor cost to a minimum • Coal is the safest fuel to store and use • No smoke or dust problems when coal is burned with modern equipment • Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

NATIONAL COAL ASSOCIATION
Southern Building • Washington 5, D. C.

Pumping Corrosives or Abrasives?

Get the INSIDE story for longer pump life and less maintenance


Heavy rubber or special linings molded in the case to resist corrosion and abrasion
Large prelubricated ball bearings
One-piece molded impeller and oversized shaft prevent oscillation
Easy access to corrosion-proof stuffing box
Rubber covered base
Industrial

SPECIFY *Industrial* LINED PUMPS

Lined to suit the job . . . the rubber formula most resistant to the fluids you handle can be supplied by INDUSTRIAL'S rubber compounding and lining division. Neoprene, Saran, Hypalon and Hycar are also available. INDUSTRIAL'S experienced chemists and engineers will help you select the ideal lining and pump size.

Wide range of sizes available with capacities to 450 gpm.

Write for 8-page bulletin with head, GPM and efficiency graphs.

NTRIFUGAL PUMPS · PRESSURE FILTERS · ION AND HEAT EXCHANGERS · RUBBER LININGS · WASTE TREATING EQUIPMENT

Industrial

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The firm of John R. Snell & Associates has been succeeded by the new firm, Michigan Associates, with John R. Snell and W. I Kenerson as partners. Kenerson was formerly Professor of Civil Engineering at Michigan State University.

Burns and Roe, Inc. has created a new section, the Chemical and Nuclear Section, to support other divisions of the firm that are actively engaged in chemical or nuclear engineering projects. Dr. Seymour Baron, formerly head of the Engineering Specialist Section, will take over as Technical Director.

BARON

LANDAUER

Leo Landauer, of Landauer and Shafer, is the new president of the Dallas-Fort Worth Chapter of the Texas Association of Consulting Engineers. Vice president is R. S. Smith of Fort Worth, and secretary-treasurer is Arnold Gaynor of Gregerson and Gaynor, Dallas.

James W. Wisda, Jr., Civil Engineer, has moved to new offices at 5257 East Beverly Blvd., Los Angeles.

At the annual meeting of the American Society for Testing Materials, three consulting engineers were elected to honorary membership, the Society's highest honor. They are: J. T. MacKenzie, Consultant, Southern Research Institute; H. B. Oatley, Consultant, Great Neck, N.Y.; and A. E. White, Consulting Metallurgical Engineer, Ann Arbor, Mich. Eleven members of the Society also received Awards of Merit for outstanding service. Of these, two are consulting engineers: Harrison F. Gonnerman, Oak Park, Ill. and Bruce W. Gonser, Asst. Director, Battelle Memorial Institute. An article by Gonnerman "Air Entrained Concrete" appeared in CONSULTING ENGINEER in October of 1954.

In the power engineering department of The Flour Corporation, Ltd., Otto H. Hedrich has been appointed Principal Power Engineer—Mechanical and Charles H. Bennett will serve as Principal Power Engineer—Electrical.

Michael Pope Associates and Sam Evans are now doing business as Pope and Evans, Consulting Engineers. Offices are at 21 E. 40th St., New York.

This Hallowell laboratory bench was custom built for a leading chemical manufacturer

This fine bench has a heavy-gage stainless steel top, fitted with chrome fixtures for vacuum, air and electricity. Flush-front drawers with stainless steel pulls glide smoothly on roller bearings. There is ample storage space with sliding doors and adjustable shelves in the enclosed cabinet base. Finish is baked-on charcoal gray enamel over a phosphate undercoat. You can have benches like this one in *your* laboratory or shop—designed and built to meet your specific requirements, and delivered promptly. Write us about your bench problem today. Hallowell Shop Equipment Division, STANDARD PRESSED STEEL CO., Jenkintown 66, Pa.

STANDARD PRESSED STEEL CO.

HALLOWELL SHOP EQUIPMENT DIVISION SPS

JENKINTOWN PENNSYLVANIA

New Projects Reported

By Consulting Engineers—

ARIZONA

Johannessen & Girand. 795-unit Armed Services Housing Project for Luke Air Force Base, Ariz. Dwelling units, single and duplex, for officers and airmen. Streets—grading, drainage, paving, and curb and gutter. Utilities—sanitary sewers, storm drains, domestic water supply and distribution, gas and electrical distribution including street lights, sprinkler irrigation system. $11,000,000. Client, United States Air Force.

ARKANSAS

Watson Hall. Complete sanitary sewerage system and 200,000 gal concrete water reservoir. $260,000. Client, City of Marshall, Ark. and Water & Sewer Improvement Dist. No. 1.

Complete Water Works System. $85,000. Client, City of Leslie, Ark.

H. Price Roark, Structural Eng., Edgar K. Riddick, Jr., Mechanical Eng., Erhart, Eichenbaum & Rauch, Architects. Justice Building, Little Rock, Ark. $1,500,000. Client, State of Arkansas.

Additions to Hot Springs County Memorial Hospital, Malvern, Ark. $500,000. Client, Hospital Board.

CALIFORNIA

Chester D. Walz. Bakersfield College, Bakersfield, Calif. 14 classroom buildings, adm. building, dormitories, auditorium, gymnasium, swimming pool, stadium, site development, sewers, storm drainage, and water distribution. Central heating and refrigeration plant. $10,000,000 (Mechanical, $1,800,000). Client, Wright, Metcalf & Parsons.

Central Utilities Plant, Kern County Civic Center, Bakersfield, Calif. Central boiler and refrigeration plant, underground reservoir with hydro-pneumatic water system. 1060 tons refrigeration. $628,000. Client, architect.

Engineering Design Co. Process design review of pilot plant installation for Shell Chemical Co. at Torrance, Calif. $350,000. Client, Southern Engineering & Construction Co.

Piping layout isometrics for boiler installation at Metropolitan State Hospital, Norwalk, Calif. $30,000. Client, Davis Piping Co.

Davis & Ferguson. Alterations and additions to a general hospital, including complete revision of X-ray dept., laboratory, and maternity dept. New air conditioning system, surgical dept., kitchen and dining facilities, emergency receiving facilities, and atomic cobalt cancer treatment facilities. $500,000. Client, Valley Hospital Corporation, Van Nuys, Calif.

John S. Bates & Roy M. Trotter. Enlargement of water treatment plant originally designed by this office, increasing capacity from 6 to 12 mgpd. $200,000,000 (Est. const. cost) Client, City of Antioch, Calif.

Leroy F. Greene. King Avenue Elementary School, Marysville, Calif. Wood construction, stucco exterior, steel frames. Classrooms, administration building, multi-use room, shops. $300,000. Client, Charles F. Dean, Architect.

W. B. Semco & Associates. Die casting plant to combine present facilities with those needed to manufacture Scott Atwater outboard engines (recently acquired). Plant layout, materials handling systems, etc. $4,500,000. Client, McCulloch Motors Corp., Los Angeles.

J. S. Hamel, Engineer. Mechanical and electrical design for Atomics International Building, Canoga Park, Calif. Research and development laboratory and offices with separate "hot" laboratory completely air conditioned, approximately 150,000 sq ft concrete, one-story, tilt-up, windowless building. Structural engineer, Richard R. Bradshaw. $2,000,000. Client, North American Aviation, Inc.

COLORADO

Tipton and Kalmbach, Inc. 23-mile Harold D. Roberts water tunnel. $40,000,000. Client, Board of Water Commissioners, City and County of Denver, Denver, Colo.

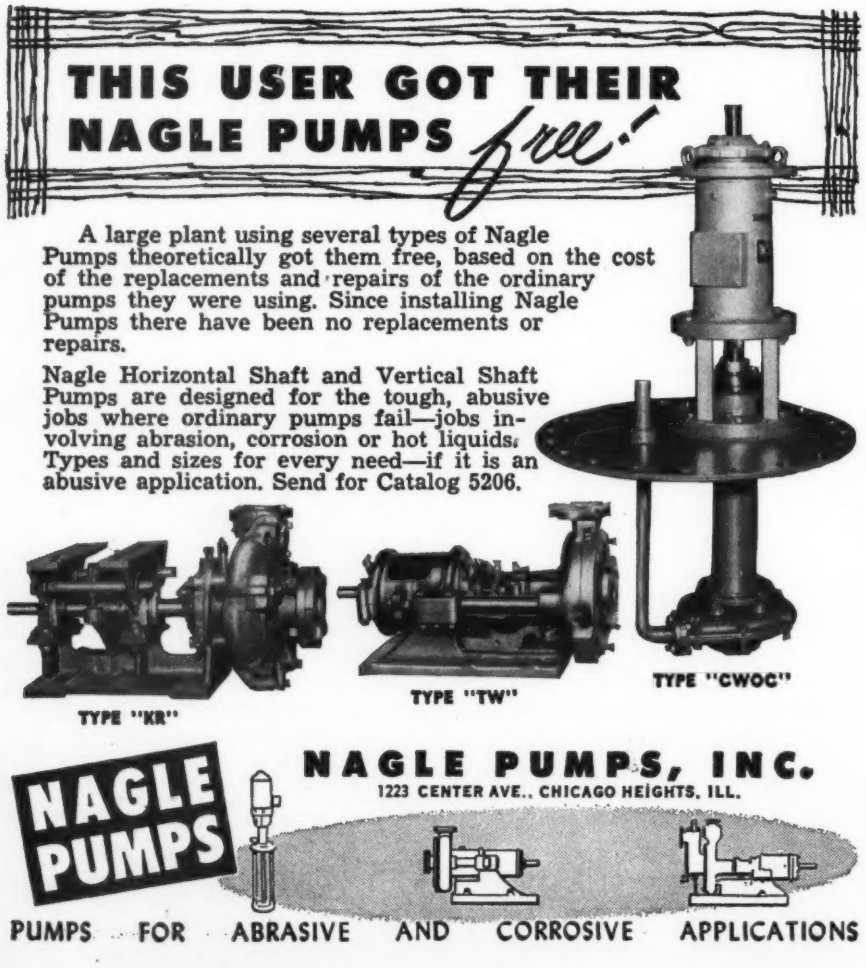
Williams Fork concrete arch dam. $2,900,000. Client, Board of Water Commissioners, City and County of Denver, Denver, Colo.

Catalytic Construction Co. Engineering, procurement, and construction for uranium processing mill at Rifle, Colo., uranium ore processing plant at Slick Rock, Colo.

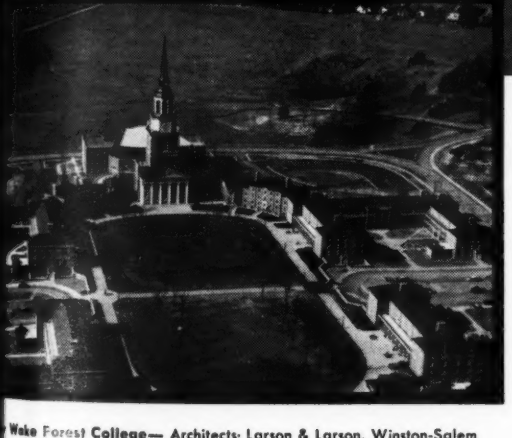
CONNECTICUT

Fred S. Dubin Associates. Princeton Knitting Mills, Watertown, Conn. Air conditioning, humidity control, ventilation. Client, Princeton Knitting Mills.

John Straus residence, Pound Ridge, Conn. Plumbing, heating, ventilating, air conditioning. $300,000. Client, architect, Edward Barnes.


THIS USER GOT THEIR
NAGLE PUMPS free!
A large plant using several types of Nagle Pumps theoretically got them free, based on the cost of the replacements and repairs of the ordinary pumps they were using. Since installing Nagle Pumps there have been no replacements or repairs.
Nagle Horizontal Shaft and Vertical Shaft Pumps are designed for the tough, abusive jobs where ordinary pumps fail—jobs involving abrasion, corrosion or hot liquids. Types and sizes for every need—if it is an abusive application. Send for Catalog 5206.
TYPE "KR"
TYPE "TW"
TYPE "CWOC"
NAGLE PUMPS
NAGLE PUMPS, INC.
1223 CENTER AVE., CHICAGO HEIGHTS, ILL.
PUMPS FOR ABRASIVE AND CORROSIVE APPLICATIONS

SPECIFY RECO



Wake Forest College— Architects: Larson & Larson, Winston-Salem
Heating Engineer: Louis Bouvier, Winston-Salem
Mechanical Contractors: Roe-Goodin-Jones Inc., Durham, N.C.; W. H. Sullivan Co., Greensboro, N.C.; J. T. Bates & Co., Winston-Salem.
Heating & Plumbing Distributors: Atlas Supply Co., Winston-Salem.

RECO . . . an old tradition at new Wake Forest College

When Wake Forest College recently made the big move to its new 19 million dollar campus, it took its traditions along. Among them: Hot Water by RECO.

For years RECO Heat Exchange Equipment kept hot water flowing at the old campus in the little town of Wake Forest, North Carolina. On the new campus in Winston-Salem, N.C., six new RECO Copper Silicon Storage Heaters now keep hot water continuously on tap for students in five dormitories and the gym. These RECO units heat and store over 10,000 gallons per hour—providing rust-free hot water in temperatures ranging from 140° to 180°F.

But RECO Storage Heaters share honors at new Wake Forest with RECO Hot Water Converters and Expansion Tanks. Five installations of this RECO team were specified to guarantee years of trouble-free hot water service.

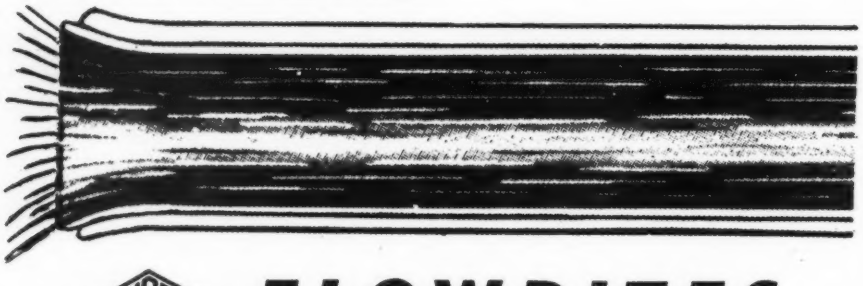
Top quality, competitive price and quick delivery are other RECO guarantees. That's why leading engineers, contractors and architects everywhere specify the full line of RECO Heat Exchange Equipment. On your next heating job—SPECIFY RECO.

For free catalogs and the name of the RECO representative nearest you, write RECO, Dept. I, 7th & Hospital Streets, Richmond 5, Va.

Richmond Engineering Co., Inc.

For this damaged tube...

THIS CURE

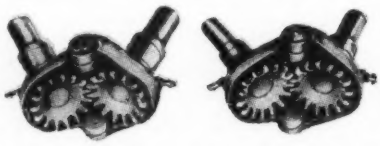


CONSECO FLOWRITES

INSURANCE AGAINST TUBE TROUBLE

Millions of times, in 25 years of service, under all conditions, FLOWRITES have proved they prevent tube end erosion. Conseco Flowrites are short molded nylon or metal tubes, inserted in the entrance end of condenser tubes. They are made of molded nylon or same metal as the tube itself. Eliminate gas and air pockets; prevent tube plugging; assure uninterrupted increased flow of water. Flowrites cost about 90% less than retubing; also prevent loss of revenue during plant shutdown. Flowrites are easy to install and repair, and are GUARANTEED. Write for special descriptive BULLETIN with M.I.T. Laboratory Report.

CONSECO UNIVERSAL GEAR BEVEL JOINTS



Solve shaft line-up problems; save on installation costs; reduce operating accidents. Positive transmission of torsion regardless of shaft angle, from 0° to 135° on vertical center line, or from 0° to 360° on horizontal center line. Capacity 1580 to 4938 inch pounds at 49 rpm. Five standard sizes for shaft diameters of ½", ¾", 1", 1¼", and 1½". Special shaft lengths to order.

Other specialties include: *coils for feed water heaters and evaporators, Conco cleaning guns and plugs, condenser ferrules, detectaleak tube testers, fibre plugs, metallic and fibre packing for condensers, Wizard condenser injectors, etc.*

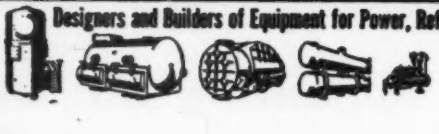
• WRITE US FOR SPECIAL BULLETINS •

CONSECO SERVICE

Conseco Service for repair or maintenance of any type or make of tubular equipment is at your service any day, any hour, Sundays, holidays, anywhere in the country. Just wire or 'phone our Service Department.

CONDENSER SERVICE & ENGINEERING CO., INC. CONSECO

Designers and Builders of Equipment for Power, Refining, Chemical and Marine Industries



163 OBSERVER HIGHWAY
HOBOKEN, N. J.

Gagarin residence. Plumbing, ventilating, electrical, Litchfield, Conn. $250,000. Client, architect, Marcel Breuer.

Colts Patent Fire Arms boiler plant survey. Client, Colts Mfg. Co.

Connecticut State Teachers College, dormitories for women, New Haven, Conn. $300,000. Client, architect, Schweikher & Carlin.

DISTRICT OF COLUMBIA

Jacob Feld. 1146-19 Street, N. W., eight-story office building, Washington, D. C. Structural design. $1,500,000. Client, Roscoe Engineering Group, owners.

1107-H Street, N. W., twelve-story office building, Washington, D. C. Structural design. $2,000,000. Client, Edwin Wethe, Architect.

John I. Thompson & Co. Contract N60921-3809, engineering services, Washington, D.C. $3900. Client, U.S. Navy Ordnance Laboratory.

India Supply Mission, engineering services, Washington, D.C. $100,000. Client, India Supply Mission.

Contract N171-1054gA, engineering services, Washington, D.C. $3000. Client, U.S. Naval Gun Factory.

Slocum & Fuller. National Shrine, Washington, D.C. $12,000,000. Client, Maginnis, Walsh & Kennedy.

FLORIDA

Russell & Axon. Water works improvements consisting of extensive water treatment plant additions, additional storage facilities, and distribution system extensions. $550,000. Client, City of Belle Glade, Fla.

Rehabilitation of existing sewage collection system. $1,400,000. Client, City of Lake Worth, Fla.

ILLINOIS

Beling Engineering Consultants. McGinnis-England Veternary Hosp., Peoria. Client, Lankton-Ziegele-Terry.

Schmuhl School addition, New Lennox, Ill. Client, Kruegel, Wilkins.

Wolfe Sagalovitch. Geneva, Ill., remodeling and enlargement of sewage treatment plant. Activated sludge plant for a design flow of 1.2 mgd Client, City of Geneva, Ill.

INDIANA

Beling Engineering Consultants. Indiana University Extension, Gary, Ind. Client, Beine, Hall & Curran.

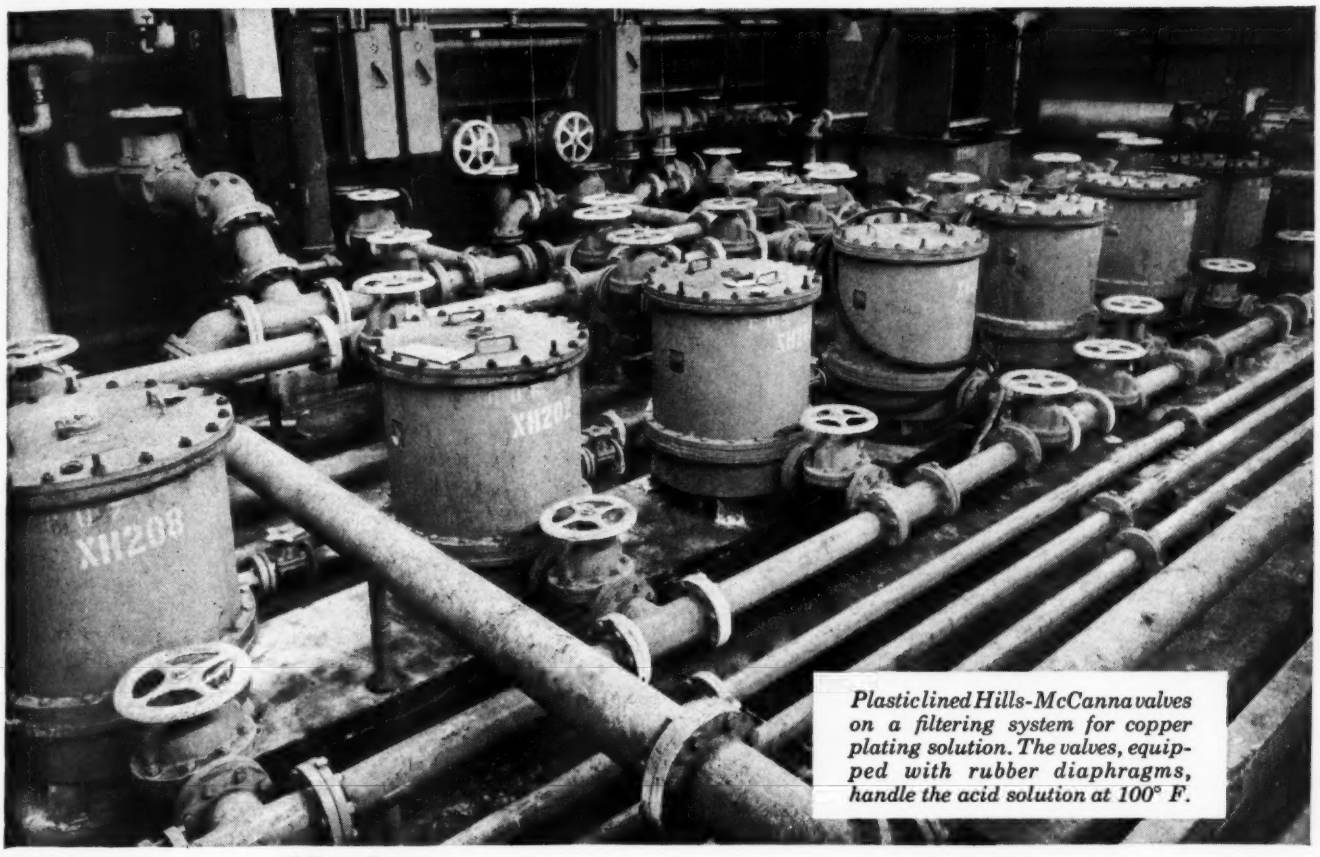
IOWA

Johnson and Johnson. Gypsum products plant, Fort Dodge, Iowa. Client, The Celotex Corp.

Beling Engineering Consultants. Iowa Wesleyan College, Science Hall, Mt. Pleasant, Iowa. Client, Morgan & Associates.

Iowa-Illinois Telephone Co., New London, Iowa. Client, Morgan & Associates.

Chemical Resistance . . . Low Maintenance . . . Positive Shut-Off



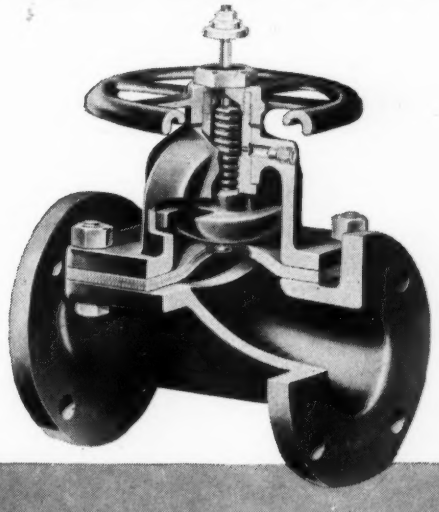
Plastic lined Hills-McCanna valves on a filtering system for copper plating solution. The valves, equipped with rubber diaphragms, handle the acid solution at 100° F.

You get all three with Hills-McCanna Diaphragm Valves

You can put an end to three common problems in the valving of corrosives and hard-to-handle fluids:

1. **End chemical attack**—Choice of 27 body materials and linings lets you match Hills-McCanna valves to the service. In addition, Hills-McCanna design isolates working parts from the flow by means of a diaphragm, available in a broad choice of materials.
2. **End frequent, troublesome maintenance**—There is no packing to replace in Hills-McCanna valves, no working parts contact the chemical fluid.
3. **End costly leakage**—Closure in Hills-McCanna valves is made by compressing a resilient diaphragm against a weir to effect a completely leakproof closure.

Put all these advantages to work in your plant. Ask your Hills-McCanna representative for full information or write for the Hills-McCanna valve catalog.



HILLS-McCANNA...

Corrosion Specialists Since 1870

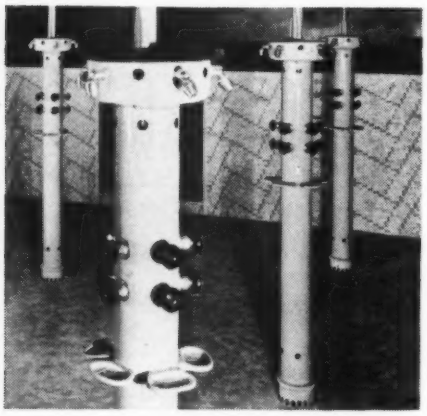
HILLS-McCANNA CO.

2446 W. Nelson St. Chicago 18, Illinois

Manufacturers of: Saunders Patent Diaphragm Valves • Chemical Metering and Proportioning Pumps • Force Feed Lubricators • Light Alloy Castings

PROVIDE FOR SHOWER BATHS *this economical way*

Above—two 3-Stall Shower Units placed against wall, provided with stall partitions and curtains.



The use of Columns alone is becoming popular too. Space to give all ample room and each person with complete control of water temperature and flow. Each of the Columns shown serves five bathers simultaneously.

In the Inland Steel Company plant, Bradley Showers and Washfountains provide the usual washing facilities plus shower baths.

Save Space, Installation Time and Cost

Like Washfountains for modern sanitary washing, Bradley multi-person Showers are becoming the accepted means of providing shower baths economically.

Bradley Group Showers come to you partially assembled for quick, less costly installation. The central Column whether used alone or with partitions is complete with drain fittings, shower heads, soap trays, hot and cold water controls and mixing chambers.

For a Bradley 5-Shower unit only *three* piping connections are required instead of *15* required for five conventional showers.

Sketches show the 5-Stall, 3-Stall and the 2-Stall (corner of room type) units. All can be had with or without partitions.

Here's the modern economical way to provide shower bath facilities. On pages 22 to 26 of Catalog 5601, all data and specifications are given. If you haven't a copy on hand, write today. BRADLEY WASHFOUNTAIN CO. 2335 W. Michigan Street, Milwaukee 1, Wisconsin.

Write today for Catalog 5601

BRADLEY multi-stall showers

Distributed Through Plumbing Wholesalers

Rowley Masonic Home, Perry, Iowa. Client, Morgan & Associates.

Graceland College Chapel, Lamoni, Iowa. Client, Morgan & Associates.

Iowa-Illinois Telephone Co., Donnelson, Iowa. Client, Morgan & Associates.

MARYLAND

Thomas S. George. Office building, warehouse, shops for Eastern Shore Public Service Co., Salisbury, Md. $2,500,000. Client, Malone & Williams, Architects.

W. H. Lemmel Junior High School, City of Baltimore, Md. $2,750,000. Client, Adams & Rigg, Architects.

MASSACHUSETTS

Fred S. Dubin Associates. Northampton Hospital addition, Northampton, Mass. Plumbing, heating, electrical, and piping. Client, Elroy Webber, Architect.

Skidmore, Owings & Merrill. Two-unit dormitory with structural frame of steel and exterior walls of brick, aluminum, and glass. Client, Smith College, Northampton, Mass.

MICHIGAN

Giffels and Vallet. Fiberboard plant, L'Anse, Mich. Client, Celotex Corp.

John C. Norton & Associates. Water system. $125,000. Client, City of Harrison, Mich.

Sewage treatment plant and sewers. $250,000. Client, Village of Roscommon.

Sewers and treatment plant additions. $150,000. Client, City of St. Ignace, Michigan.

Fred S. Dubin Associates. Wayne University, Detroit, Mich., Conference Hall. Consulting on air conditioning. $1,000,000. Client, architect, Minoro Yamasaki and Associates.

John R. Snell & Associates. Overpass and approaches U.S. 12, west of Jackson at Sandstone Rd. $170,000. Client, Michigan Highway Dept.

Overpass and approaches U.S. 12, west of Jackson at Blackman Rd. $130,000. Client, Michigan Highway Dept.

MINNESOTA

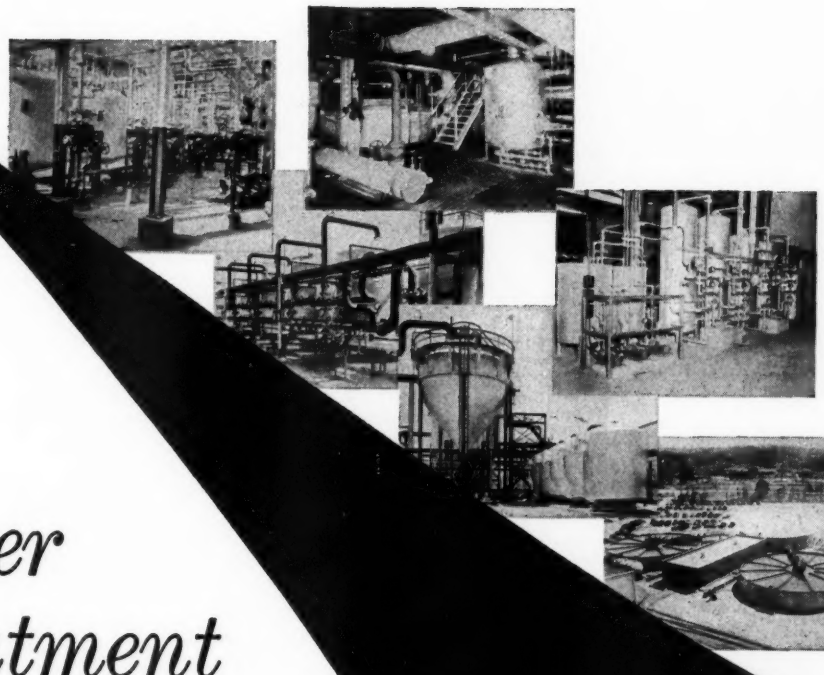
Nielsen and Bruch. New high school for Kasson-Mantorville School District, Kasson, Minn. $800,000 (est.) Client, Swanson, Matson & Wegleitner, Arch.

J. A. Lindsey, Sr. Sanitary sewer system and sewage treatment plant. $222,000. Client, Village of Dassel, Minn.

Blaw-Knox Co., Chemical Plants Div. Design and erection of vegetable oil deodorizing system, Mankato, Minn. Client, Honeymead Products Co.

MISSOURI

Smith-Hanlon-Zurheide-Levy, Inc. Passionist Fathers Monastery, School, and Retreat, Warrenton, Mo. $2,250,000. Client, Passionist Fathers.



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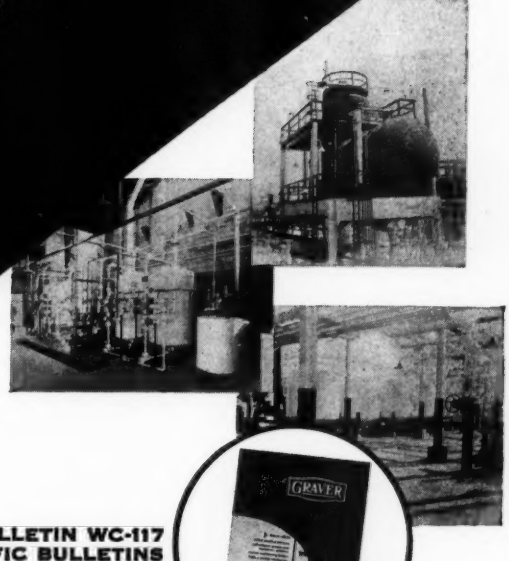
FOR FIFTY YEARS

Hot Process Softeners • Deaerating Heaters
Cold Process Softeners and Clarifiers
Demineralizers • Zeolite Softeners
Hot Zeolite Softeners • Filters
Continuous Boiler Blowdown Equipment
Dealkalizers



WRITE FOR GENERAL BULLETIN WC-117 AND SPECIFIC BULLETINS

Industrial Department I-211

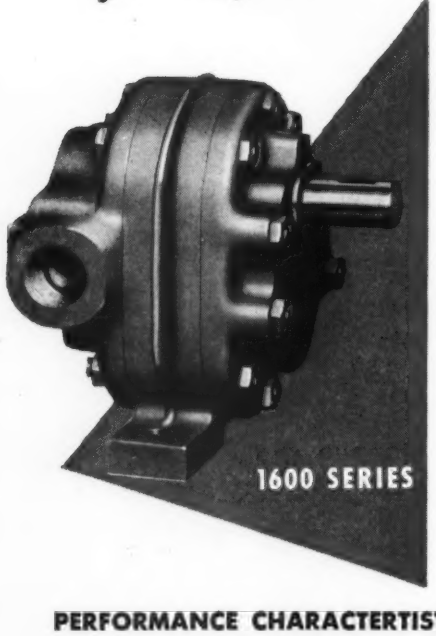
GRAVER®

GRAVER WATER CONDITIONING CO.
Division of Graver Tank & Mfg. Co., Inc.
216 West 14th Street, New York 11, N. Y.

The new **ROPER**

HYDRAULIC PUMP-MOTOR

for Improved **INDUSTRIAL SERVICE**



Designed by the same engineers who developed the famous Roper Rotary Pumps, the new Roper Hydraulic Pump-Motors operate on the same principle using two equal size, smooth-running gears in a precision-fitted case. These units offer low-speed and high-torque (much needed in the hydraulic field), and their versatility finds them well-suited to heavy-duty service within their operating range. They run equally well in either direction both as pumps or motors . . . they can be direct-connected without speed reducers, thus conserving space . . . they are easily installed, easy to operate, and are long on economy. Perhaps *you* have equipment that can be further improved with a Roper Hydraulic Pump-Motor. Send for all the facts today.

PERFORMANCE CHARACTERTISTICS

Available in foot and flange mounted models. Recommended speed range on larger sizes is from 200 to 800 RPM with pressures to 800 PSI In this range, Roper units require from 7 to 40 GPM flow and will develop up to 11.5 HP output at maximum speed and pressure. Smaller sizes may be operated up to 1200 RPM and up to 800 PSI which will require a flow of 16 GPM to develop up to 5 HP.

SEND FOR BULLETIN 22

ROPER
Rotary Pumps

GEO. D. ROPER CORPORATION • 649 Blackhawk Park Ave., Rockford, Ill.

John I. Thompson & Co. Contract DA 36-022-TC-6780, engineering services, St. Louis, Mo. $12,690. Client, U.S. Army, Transportation Supply & Maintenance Command.

Fred S. Dubin Associates. Parkway Junior-Senior High School, St. Louis, Mo. Plumbing, electrical, heating. $1,200,000. Client, architect, Hellmuth, Obata & Kassabaum.

Stephens College master utility plan, Missouri. Client, architect, Murphy & Mackey.

University of Washington (Mo.) Library. $3,500,000. Client, architect, Murphy & Mackey.

MONTANA

Wesley Bintz. Circle, Montana, combination BINTZ Pool and Community Building. Outdoor pool is 40 x 60 ft, ovoid, bathhouse of 1,420 sq ft. Community Building is 30 x 60 ft, two stories with sun deck. $85,000 (est.) Client, Board of Trustees of McCone County Memorial Building & Recreation Association.

Associated Engineers. New 34.5 kv transmission and 7.2/12.45 kv distribution line. $200,000. Client, McCone Co. Elec. Coop., Inc., Circle, Mont.

NEVADA

Adrian Wilson & Associates. Preliminary plans for Convention Center in Las Vegas, Nev. Reinforced concrete, thin-shelled dome with thermo lightweight concrete, no interior beams. Seating capacity of 6000. First phase of a proposed civic center estimated to cost $15-20 million. Client, Clark County Fair & Recreation Board.

NEW JERSEY

The Ballinger Co. Additions and alterations to Salem County Memorial Hospital, Salem, N.J. $500,000.

NEW YORK

Jacob Feld. Office building—full block. E/S Park Ave. and 47 to 48 Streets, New York City. Structural design. $25,000,000 (est.) Client, Leon Levy & Lionel Levy, Architects.

Gruenwald Associates. Milk processing plant. $500,000. Client, Crestwood Dairy, Inc., Lynbrook, L.I., N.Y.

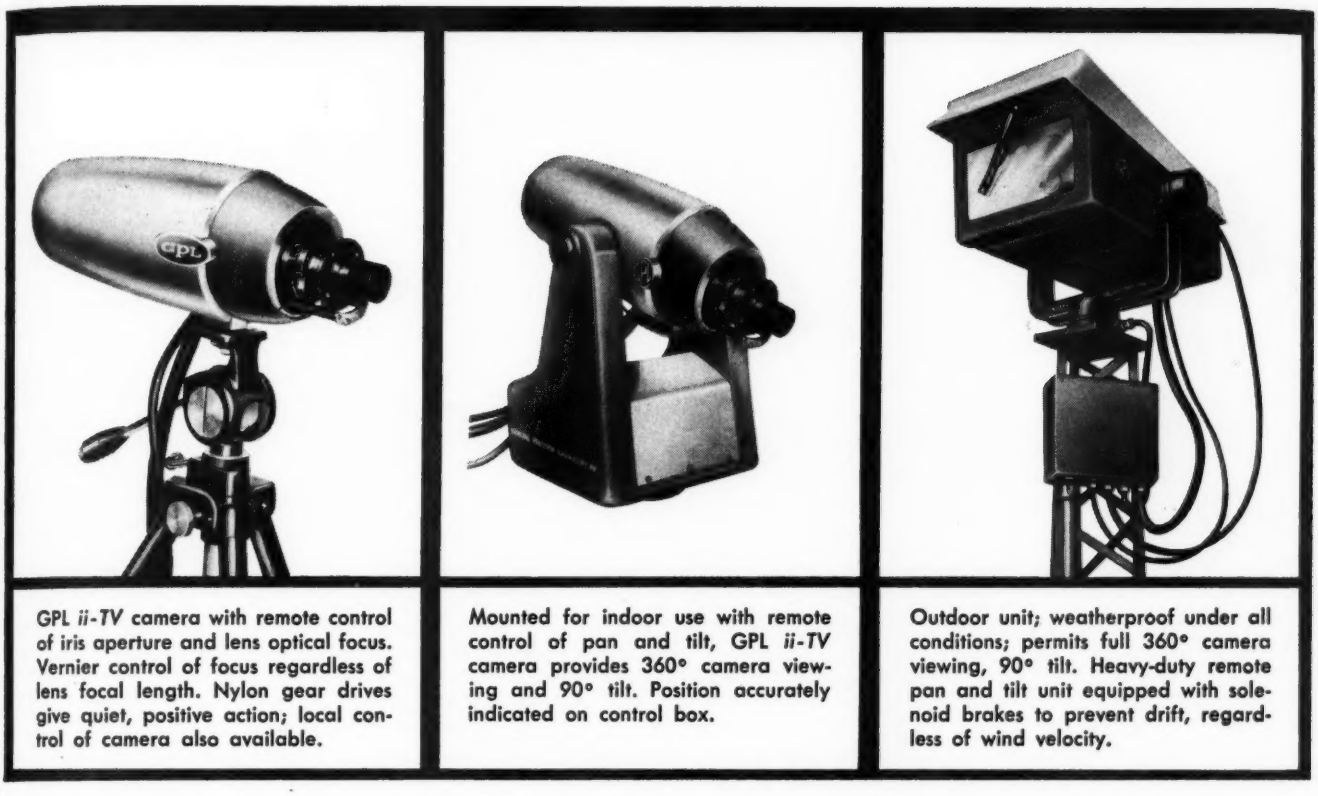
Milk processing plant. $130,000. Client, Sunnydale Farms, Inc., Brooklyn, N.Y.

Milk processing and depot plant. $400,000. Client, Sunnydale Farms, Inc., Brooklyn, N.Y.

Nussbaumer-Clarke & Velzy. Sewage treatment plant. Remodeling and additions to provide primary treatment for 60,000 persons. $1,200,000. Client, Jamestown, N.Y.

Sewage treatment plant. Remodeling and additions. Booster pumping station, 30 & 36 in. force mains and sewers for Fourth Ward. $2,000,000. Client, Lackawanna, N.Y.

Gennaro Mianulli. Queen of Angels Roman Catholic School, Long Island



GPL *ii-TV* camera with remote control of iris aperture and lens optical focus. Vernier control of focus regardless of lens focal length. Nylon gear drives give quiet, positive action; local control of camera also available.

Mounted for indoor use with remote control of pan and tilt, GPL *ii-TV* camera provides 360° camera viewing and 90° tilt. Position accurately indicated on control box.

Outdoor unit; weatherproof under all conditions; permits full 360° camera viewing, 90° tilt. Heavy-duty remote pan and tilt unit equipped with solenoid brakes to prevent drift, regardless of wind velocity.

Complete Remote Control with GPL *ii-TV*®

GPL's *industrial-institutional* closed-circuit TV system

There's *ii-TV* closed-circuit equipment to fit every industrial "seeing" problem. And GPL's skilled application engineers will be glad to help you select the system best suited to your need.

GPL *ii-TV* is designed, built and engineered by men who have the highly specialized skills required to produce top quality equipment. Every piece in the *ii-TV* System reflects GPL's extensive experience in the production of high performance television systems to meet the rigid standards of the Armed Services and broadcasting studios.

Investigate the bright, clear picture, rugged construction, dependability and all-around economy of the outstanding GPL *ii-TV* System. Compare—and you'll see that nothing is more economical than the best.

Dangerous processes of any kind can be closely controlled in complete safety with GPL *ii-TV*. System's remote control features are equally effective in countless other industrial applications.

For further information, or application engineering assistance, write or contact:

General Precision Laboratory Incorporated
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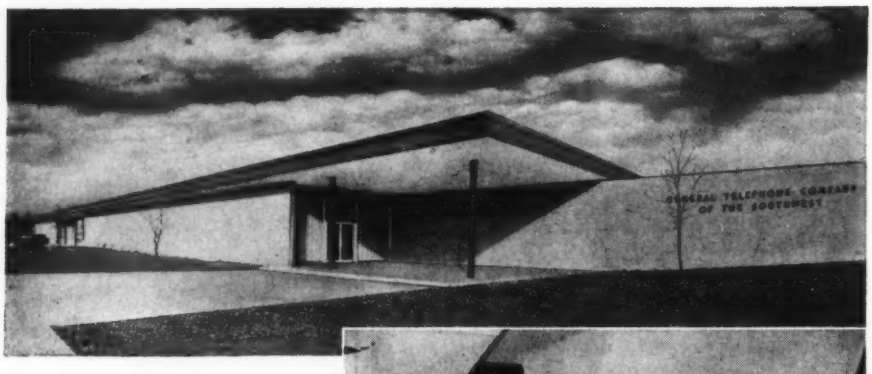
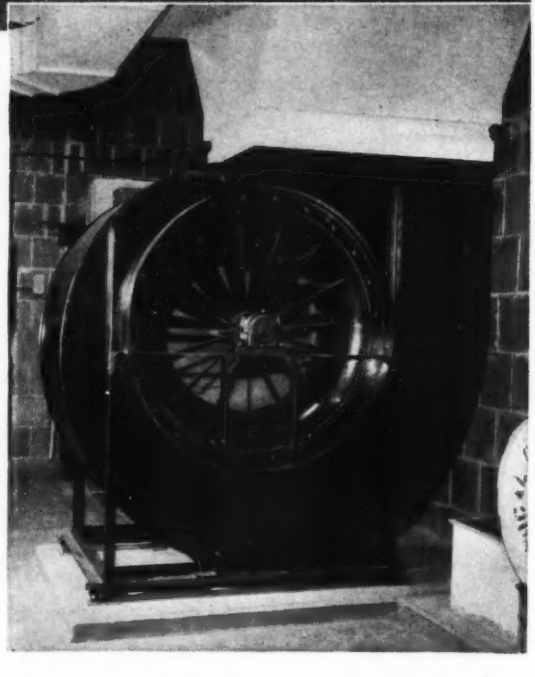


New office building of General Telephone Company of the Southwest, San Angelo, Texas. Pace Associates, Architects; Evans & Taylor, General Contractor; Bollinger & Sames, Plumbing & Heating Contractor.



SMOOTH EFFICIENCY IN AIR HANDLING!

Inlet side of one of the five "Buffalo" Type BL Fans in the new building. Note the smoothly curving inlet bell and directional inlet vanes for quiet, efficient entry of air. Rotor has curved flange matching inlet, and backward curved blades for matchless performance. For full details, write for Bulletin F-100.

8 "BUFFALO" FANS MOVE THE AIR IN THIS PRIZE-WINNING TELEPHONE BUILDING

It is no coincidence that this new General Telephone Company of the Southwest Building was a prizewinner in the American Institute of Architects competition for 1955 — its low, sweeping lines blend well with the finest residential style. And it is no coincidence that "Buffalo" Fans were selected for its air moving jobs — and that complete satisfaction is reported by owner and contractors alike.

For ventilation and air conditioning supply, two "Buffalo" Belted Vent Sets, and five "Buffalo" Type BL Ventilating Fans are giving quiet, efficient service. Dependable induced draft is supplied by a "Buffalo" Type MW Industrial Exhauster.

Assure the greatest satisfaction on your next job by specifying "Buffalo", the fans with the "Q" Factor* — as leading contractors, engineers and owners have been doing for the past 79 years.

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

BUFFALO FORGE COMPANY
BUFFALO, N. Y.
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING
FORCED DRAFT COOLING HEATING PRESSURE BLOWING

City. $50,000. Client, John O'Malley, Architect.

St. Gabriel Roman Catholic School and Church, Brooklyn, N.Y. $850,000. Client, John O'Malley, Architect.

Foundation Housing Project. $800,000. Client, A. Happi, Architect.

Stuart H. Snyder. Romax Building, four-story reinforced concrete office building 76 x 148 ft, flat plate, poured-in-place construction. Syracuse, N.Y. $400,000. Client, Roock & Goffredo, Architects.

Ukranian Home. Two story steel frame recreation building, Auburn, N.Y. $125,000. Client, Robert S. Richards, Architect.

Greenhut & Taffel. Railroad station redevelopment and shopping center for the New York, New Haven & Hartford Railroad Company, New Rochelle, N.Y. $17,000,000. Client, New Rochelle Development Corp.

Two pre-stressed reinforced concrete bridges on Saw Mill River Parkway at Tuckahoe Road, Yonkers, N.Y. $860,000. Client, Westchester County Parkway Commission.

Huxley Madeheim. Martins' Store in Great South Bay Shopping Center, Babylon, L.I. Air conditioning, heating, and emergency gas engine electric generating set. $200,000. Client, Martins.

Peter Elbal. Martins' Store in Great South Bay Shopping Center, Babylon, L.I. Air conditioning, heating, and emergency gas engine electric generating set. $200,000. Client, Tiller-Berges.

The Ballinger Co. Modernization and expansion of Chenango Memorial Hospital, Norwich, N.Y. $900,000.

Slocum & Fuller. Pittsburgh Plate Glass Research Center, N.Y. $8,000,000. Client, Skidmore, Owings & Merrill.

425 Park Avenue. $11,000,000. Client, Kahn & Jacobs.

Methodist Hospital, Brooklyn, N.Y. $4,000,000. Client, Rogers & Butler.

Herman Kron, Consulting & Architectural Engineer. One-story brick building for gas station, lubritorium, auto laundry, and office. Will be of front brick, equipped with unit heater. Size, 62 x 30 ft, Brooklyn, N.Y. $18,000. Client, L. B. Oil Co.

Fred S. Dubin Associates. Addition to Museum of Modern Art, New York. Plumbing, heating, air conditioning, electrical. $1,000,000. Client, architect, Philip Johnson.

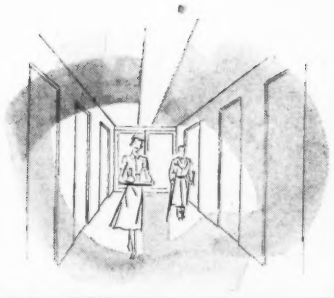
University of Buffalo, N.Y., Fine Arts Center, plumbing, heating, air conditioning, electrical. $1,200,000. Client, architect, Paul Schweikher.

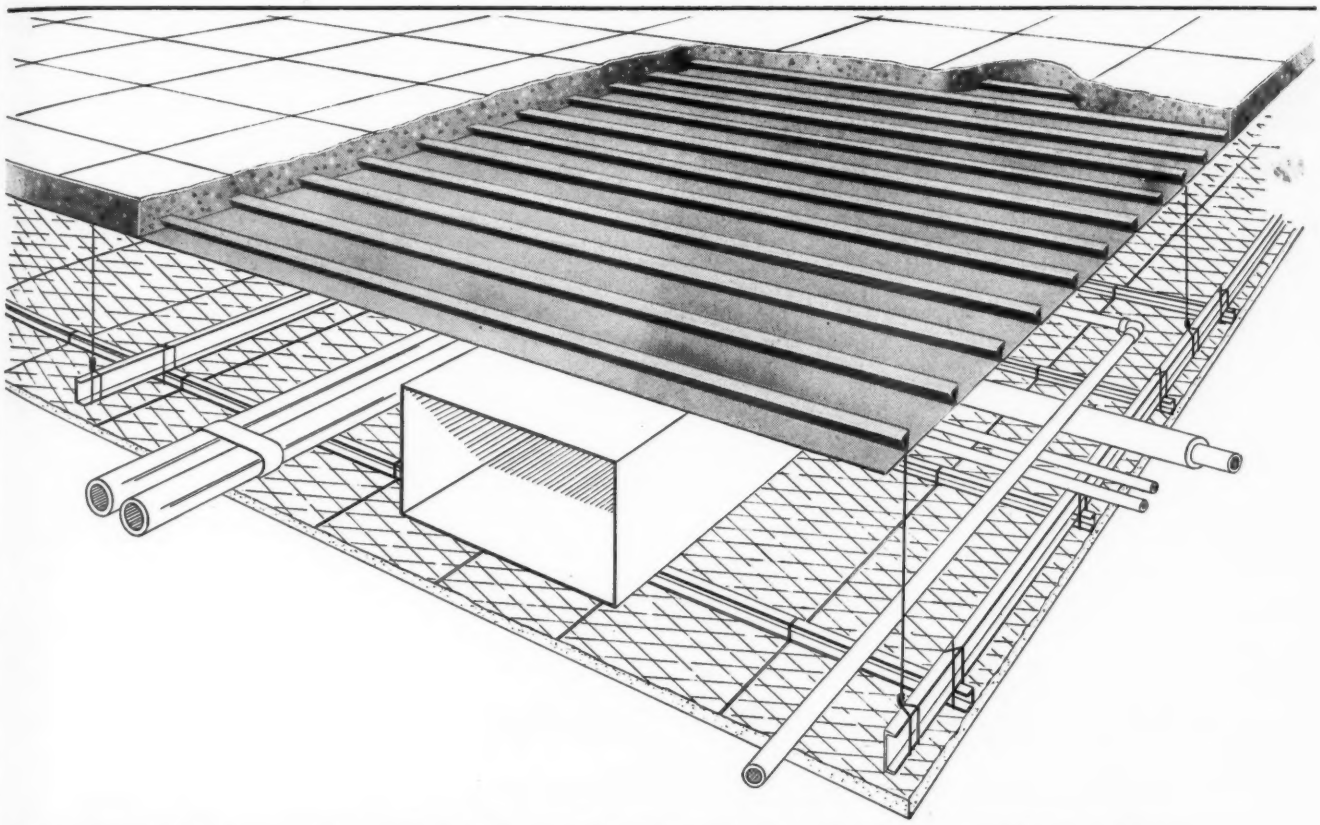
Hillburn restaurant and lounge, Suffern, N.Y. Heating, air conditioning, electrical, plumbing, fire protection. $300,000. Client, Junzo Yoshimura & Thompson & Steinhardt, Architects, and Motel on the Mountain Corp.

NORTH DAKOTA

L. W. Burdick. Water and sewage sys-

New *Fenestra* design idea for hospital corridors





NEW WAY TO WIN THE BATTLE OF THE CAVITY

Holorib Reinforcing Floor Forms span corridors without intermediate beams . . . provide large area, unobstructed plenum chambers for services.

Modern hospital mechanical requirements often create structural problems for architects and engineers. Fenestra* Galvanized Holorib Reinforcing Floor Forms spanning the corridors can simplify your detailing and make construction easier.

This unique product eliminates bar joists or intermediate beams on spans up to 10 feet—ideal for corridors. It provides an unobstructed plenum chamber for services. A floor slab only 3 inches thick will carry 120 pounds per square foot live load on a 10-foot span.

Galvanized Holorib Reinforcing Floor Forms function as *both permanent incombustible formwork and reinforcing steel*—replacing rods—for concrete slab construction in either structural steel, frame or reinforced concrete buildings. No shoring is required for 8-foot spans and shoring at mid-span only for longer spans and deeper slabs.

In addition to this specialized application, there are many other advantages in using Fenestra Galvanized Holorib Reinforcing Floor Forms for concrete slab construction in all kinds of buildings. Your Fenestra Representative will be happy to give you complete engineering data for your designs. Call him today—listed in the Yellow Pages—or mail the coupon below. *Trademark

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Your Single Source of Supply for BUILDING PANELS · WINDOWS · DOORS

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Dept. CE-9, 3443 Griffin Street, Detroit 11, Michigan
Please send me complete information on Fenestra Holorib Reinforcing Floor Forms for hospital corridors.

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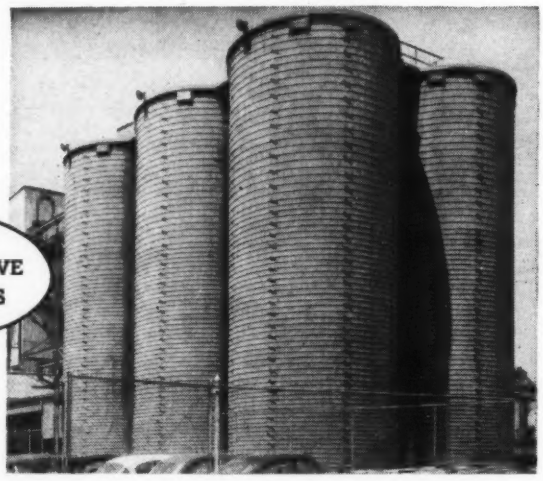
ADDRESS_____
CITY_____ STATE_____

There's a heavy conveying system atop these Neff and Fry Bins



SUPER-CONCRETE STAVE STORAGE BINS

A continuous reinforced concrete roof on the six 20' x 52½' bins carries a big screw conveyor with piers, chutes, etc. Observe that there are no additional supports from the ground. The bins themselves support the entire load.

This strikingly proves the load-bearing strength of Neff & Fry Bins. Of course, the bins also have the lateral strength to contain 4,000 tons of grain.

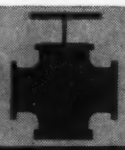
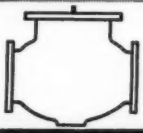
The walls of Neff & Fry Bins are constructed of Super-Concrete Staves. For a complete understanding, read our folder, "Bins With the Strength of Pillars." Ask for it now before you forget.

NOT EXPORTED
EXCEPT TO CANADA AND MEXICO

THE NEFF & FRY CO.
302 ELM ST. • CAMDEN, OHIO

YOU JUDGE THE BETTER BUY!

FOR A 6" VALVE INSTALLATION OPERATED AN AVERAGE OF 55 TIMES A DAY FOR 9 YEARS

Case History	 GATE VALVE "A"	 G.A. FLOWTROL VALVE
REPAIRS	FREQUENT	NONE
REPLACEMENT	EVERY 3 MONTHS	NONE
ORIGINAL COST	$60.00	$360.00
APPROXIMATE TOTAL COST	over $2,000.00	$360.00

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GOLDEN ANDERSON Valve Specialty Company
1281 RIDGE AVE., PITTSBURGH 33, PA.

Designers and Manufacturers of **VALVES FOR AUTOMATION**

tem, Hannaford, N.D. $43,000. Client, City of Hannaford.

Sanitary sewer and water extensions, Harvey, N.D. Client, City of Harvey.

Sanitary sewer and water extensions, Mayville, N.D. $40,000. Client, City of Mayville.

OHIO

W. B. Huff & Associates. Doylestown Elementary School, 12 classrooms, 2 kindergartens, multi-purpose room, kitchen, and offices. $400,000. Client, Chippewa Local School District, R.D.#1, Doylestown, Ohio.

OREGON

Ray W. Preston. Park Rose Thompson St. Elementary School. Electrical work. $489,000. Client, Annand, Boone & Lei.

Fisch-Or Building, Portland, Ore. Electrical work. $200,000. Client, Roscoe Hewenway, Architect.

N. W. Haner & Associates. Sanitary sewers and storm drains, St. Helens, Ore. $500,000. Client, City.

PENNSYLVANIA

Vern E. Alden Co. Mineral fiber acoustical tile plant, near Pittston, Pa. Client, The Celotex Co.

Brown, Blauvelt and Leonard, Consulting Engineers. Design of new cuprous chloride manufacturing facilities, Philadelphia. Client, Henry Bower Mfg. Co.

Harris, Henry & Potter, Inc. Storm drainage system, Willow Grove, Pa. $30,000, Client, Upper Moreland Twp.

Sanitary system, Willow Grove, Pa. $30,000, Client, Upper Moreland Twp.

H. A. Kuljian & Co. Ellwood Elementary School for 525 students, reinforced concrete. $835,000. Client, City of Philadelphia Board of Education.

Fred S. Dubin Associates. Howard Johnson Motor Lodge, Breezewood, Pa. Plumbing, heating, air conditioning, electrical. $300,000. Client, Joseph Bortz and architect, Carl Koch Assoc.

The Ballinger Co. Additions and alterations to Chambersburgh Hospital, Chambersburgh, Pa.

Slocum & Fuller. Sheraton Hotel, Philadelphia, Pa. $8,800,000. Client, Perry, Shaw, Hepburn & Dean.

Gruenwald Associates. Refrigerating plant. $40,000. Client, Sunnydale Farms, Inc., Elliottsburgh, Pa.

Power plant. $150,000. Client, Sunnydale Farms, Inc., Galeton, Pa.

RHODE ISLAND

Fred S. Dubin Associates. Rhode Island School of Design. Five new buildings including dormatories, social hall, and classrooms. Plumbing, heating, ventilating, electrical. $2,500,000. Client, architect, Cull, Robinson & Green.

John Brown Nichols Museum, Providence, R.I., air conditioning. $300,500.

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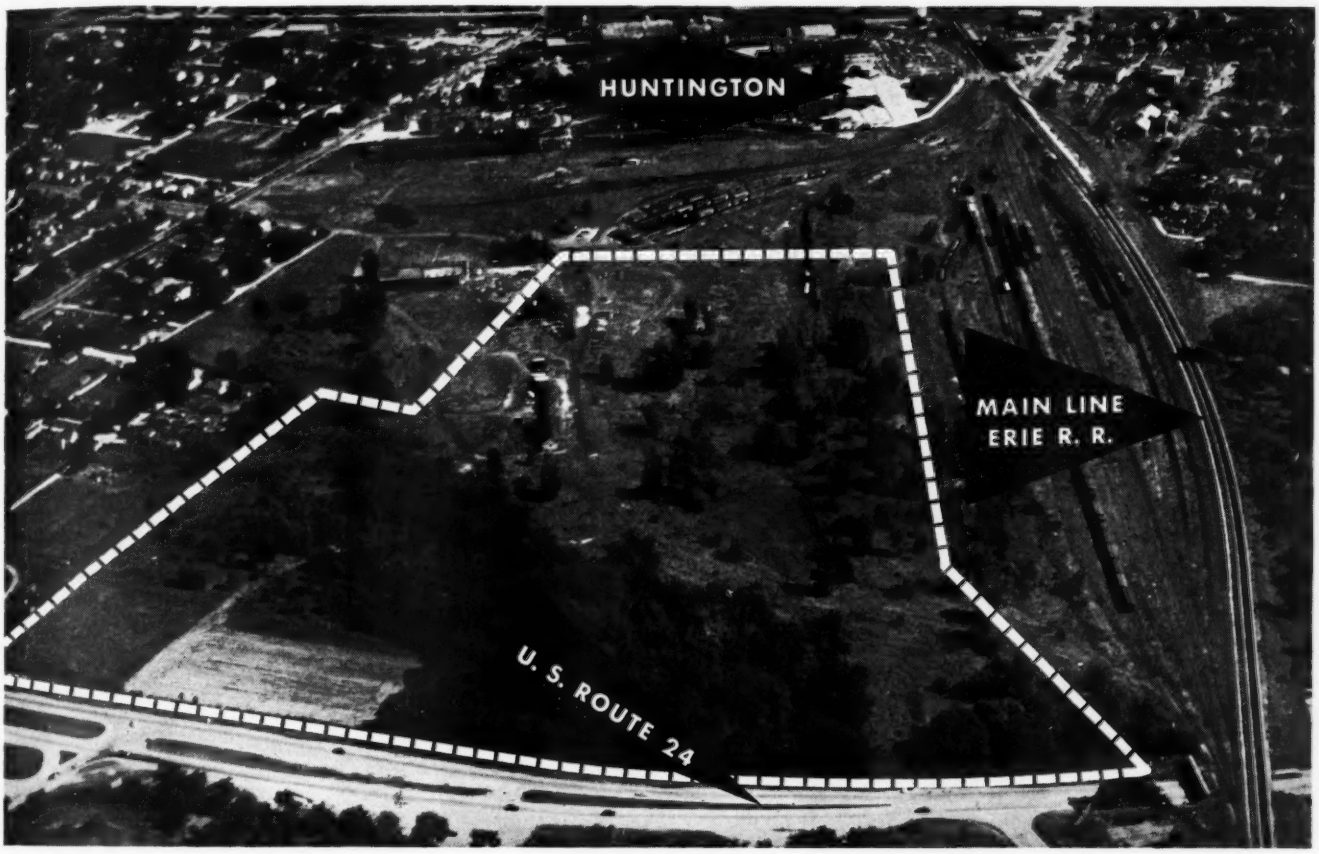

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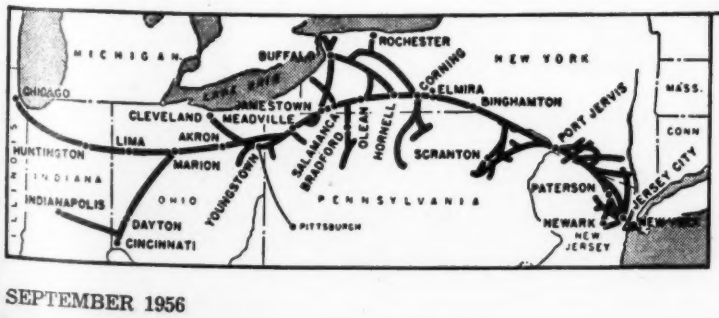

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Industrial Development
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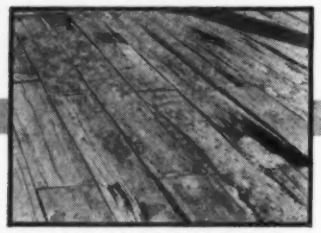

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Client, architect, Cull, Robinson & Green.

Sharpe residence. Heating, air conditioning, Rhode Island. $80,000. Client, architect, Hugh Stubbins Assoc.

Gruenwald Associates. Textile plant (Utility Division) $35,000. Client, Greenville Finishing Co., Providence, Rhode Island.

SOUTH CAROLINA

Harza Engineering Co. Hydroelectric power plant, Hartwell Project, Savannah River, South Carolina and Georgia. $17,900,000. Client, Corps of Engineers, Department of the Army.

TENNESSEE

Richard W. Evans & Associates. New Store building, Nashville, Tenn. Air conditioning system, general construction. Architects, Marr & Holman. $750,000. Client, The Cain-Sloan Co.

TEXAS

Forrest and Cotton. Plans and specifications for grading, drainage, paving, and utilities for the University of Dallas, Texas. $200,000. Client, Trustees, University of Dallas Trust.

Plans and specifications for dam and reservoir on Sabine River at Iron Bridge site. $20,000,000. Client, Sabine River Authority of Texas.

Plans and specifications for grading, drainage, paving, and utilities for installment No. 16 of the Trinity Industrial District, Dallas, Texas. Approximately 54 acres. Client, Industrial Properties Corp.

The Fluor Corp., Ltd. Design, engineering, and construction of butadiene plant, Odessa, Texas. Client, The Odessa Butadiene Co.

R. Marvin Shipman. High school plant, Victoria, Texas, structural design. $1,700,000. Client, P. G. Silber, Architect.

H & M Engineering Co., McClendon & Associates. Parkdale Village Unit 2, Texas. $89,148. Client, T. J. Bettes Co.

UTAH

Catalytic Construction Co. Engineering, procurement and construction for uranium ore processing plant at San Miguel, Utah.

WYOMING

Miner and Miner, Consulting Engineers, Inc. 250 mi telephone lines with associated central office and carrier equipment near Basin, Wyo. $225,000. Client, Tri County Telephone Association, Inc.

FOREIGN

N. W. Haner & Associates. Cooper Lake hydroelectric project. Dam, penstock, and powerhouse, 15,000 kw. $5,000,000. Client, Central Alaska Power Assoc., Anchorage, Alaska.

Galena and Nakanek Air Bases, Alaska. Development of master plan and basic machine planning. Client, United States Air Force. ▲▲

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DESIGN OF PRESTRESSED CONCRETE STRUCTURES, by T. Y. Lin; John Wiley and Sons, Inc.; 456 pp.; $11.50.

Reviewed by H. F. Gonnerman
Consulting Engineer and
Research Consultant

Professor Lin's book is intended to present a complete review of American methods and procedures in the field of prestressed concrete. The rapid development of prestressed concrete in the United States and the very great interest in this subject at the present time makes the publication of this book very timely. Professor Lin's extensive experience enables him to speak with authority on the various subjects covered in his book.

As pointed out in the preface, the book deals primarily with design and presents only those features of design peculiar to prestressed concrete. Emphasis is placed on the design of structures and on the fundamentals of design rather than on particular details. The reader is presumed to have a working knowledge of elementary structural analysis and design, of reinforced concrete, and of the strength of materials.

Throughout the book two useful and effective procedures have been employed by the author that are very helpful to the reader. These are (1) the use of numerous short examples to clarify the particular method or formula under discussion, and (2) the presentation of both elastic and ultimate designs side by side which permits comparisons to be made of design by the two methods with respect to their economy and safety.

The book comprises 16 chapters, four appendices, and an index. Accompanying each chapter is a brief up-to-date list of important references to the literature. The subjects treated in the 16 chapters of the book cover a wide scope and include among others the following: Materials; Prestressing Systems; Loss of Pre-Stress; Analysis and Design of Sections for Flexure; Problems of Shear, Web Reinforcement, Bond and Bearing; Beam Deflections and Layouts; Continuous Beams; Slabs; Circular Prestressing; Allowable Stresses and Load Factors; Fire Resistance; Corrosion Resistance; and the Economics of Prestressing. One of the four appendices contains design data for some of the currently used prestressing systems and another discusses criteria for pretressed concrete based on a publication issued by the U. S. Department of Commerce, Bureau of Public Roads, in 1954.

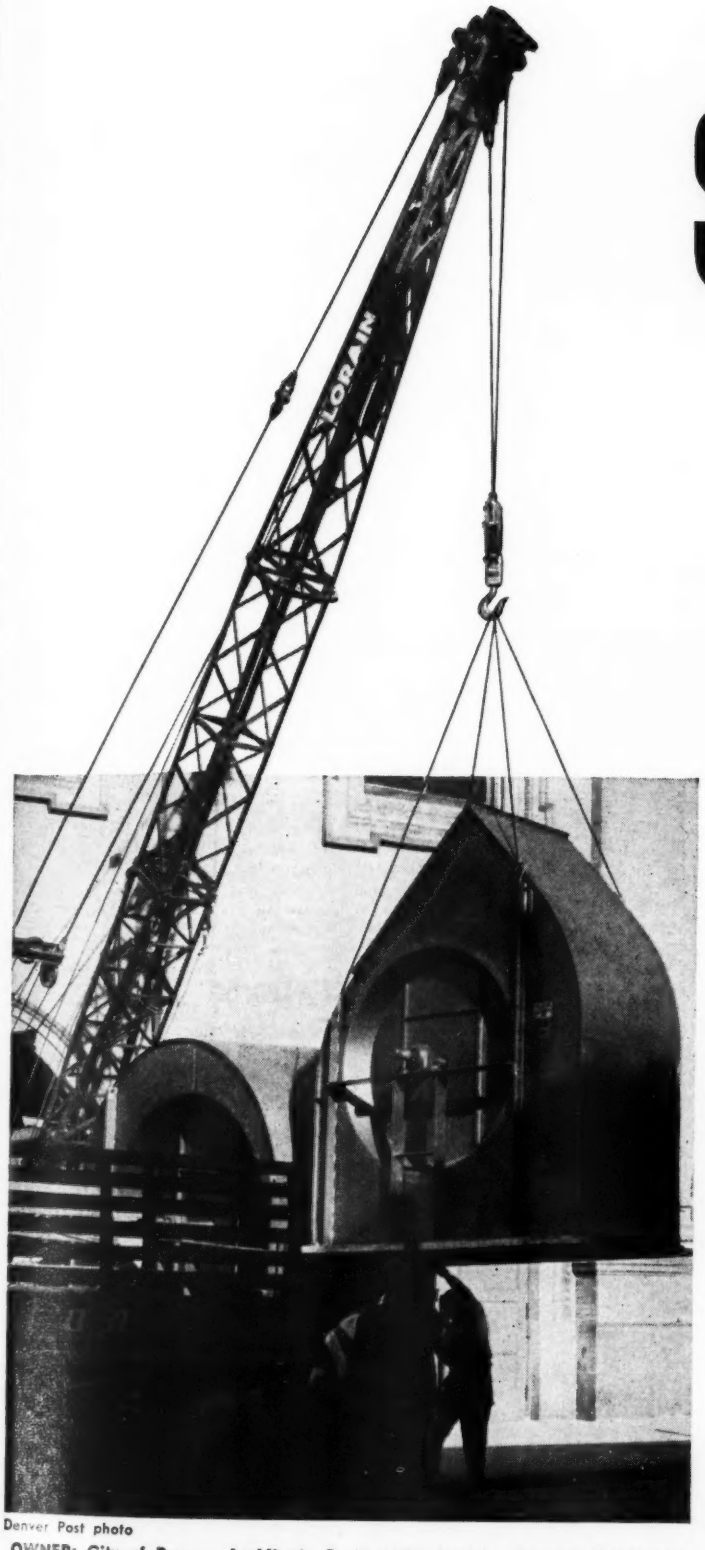
Professor Lin has presented the pros and cons of prestressed concrete in a straightforward and forthright manner. Each subject in his book is concisely and clearly discussed in considerable detail, and the book is well illustrated. The book will be found very informative and useful by practicing engineers, students, and others interested in the design of prestressed concrete.

•

GEOLOGY IN ENGINEERING, by John R. Schultz and Arthur B. Cleaves; John Wiley & Sons, Inc.; 592 pp; $8.75.

Reviewed by Woodrow W. Ramsey
Ramsey and Reeves

In the preface, the authors state: "Practicing engineers come into almost daily contact with geological matters, and there has long been need for a book which introduces



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them to the phases of geology that experience shows to be most useful in their work." This book definitely fulfills that need by integrating geology and engineering. Since engineering application of geology and engineering practice go hand in hand, this book makes an excellent reference volume.

The phases of geology which are contained in this book are definitely related to engineering practice and are presented with an engineer's viewpoint. Presentation of each phase is more analytical than descriptive with more emphasis on principles than case histories. A selected list of references at the end of each chapter gives the engineer the means to secure detailed knowledge on the particular phase of geology in question. The photographs, diagrams, sketches, and tables used in conjunction with the text are helpful in the understanding of the principles involved.

The index is composed of three parts; namely, subject matter, authors mentioned in the text, and geographical locations mentioned in the text.

Geology of soils is well presented; it is of increasing importance to engineering geology. Some of the aspects of soils covered are: soil forming processes, frost action on soils, soil mechanics, and aerial photographic interpretation of soils. E. J. Yoder is the author of the chapter on soil mechanics.

The chapters on dams, reservoirs, tunnels, highways, and airfields are presented in respect to the application of geology. The treatment of minerals, rocks, and geologic structure has been reduced in scope to give only data that is common to civil engineering. Other subjects covered are: erosion and deposition by streams, desert land forms, shore lines and beaches, glaciers and glaciations, landslides, volcanos and earthquakes, historical geology, and subsurface exploration.

The object of this book is to furnish a geological background to guide the engineer in his practice and not to make a geologist out of an engineer.

ALSO AVAILABLE

AIR CONDITIONING & ENGINEERING HANDBOOK, 2nd Ed., 1955; American Blower Corp.; $6.00.

Included in this book are fundamental principles, laws and tables; sample calculations; and a compilation of data based on the experiences of the authors and contemporary engineers throughout the country.

THE HEATING, VENTILATING, AIRCONDITIONING GUIDE 1956, 34th Ed.; American Society of Heating and Air-Conditioning Engineers; 1176 pp.; $12.00.

Particular attention has been given in this new Guide to heat transmission coefficients of building materials. Design values for conductivity and conductance are included for many more materials than in previous guides and additional tables make it easier to compute the effect of adding air spaces or insulations to walls, ceilings, or floors. Most of the chapters have been changed substantially, and new chapters have been added.

•

LEGAL CASES FOR CONTRACTORS, ARCHITECTS AND ENGINEERS, by I Vernon Werbin; McGraw-Hill Book Co., Inc.; 453 pp.; $6.00.

The author, who is both a licensed professional engineer and an attorney, has had 40 years experience of specialized legal practice in the construction field. The book discusses legal problems such as the right to make changes in the plans and specifications, contracts required to be in writing, agreement to subcontract, and liability for defective work. It is designed to forewarn you of troublesome legal pitfalls.

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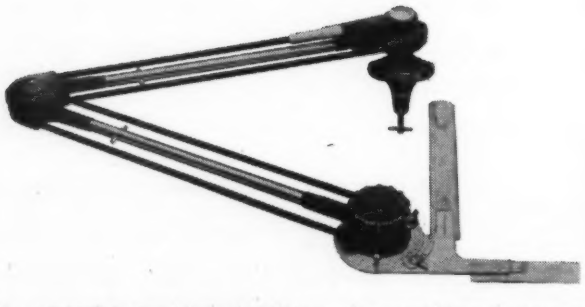

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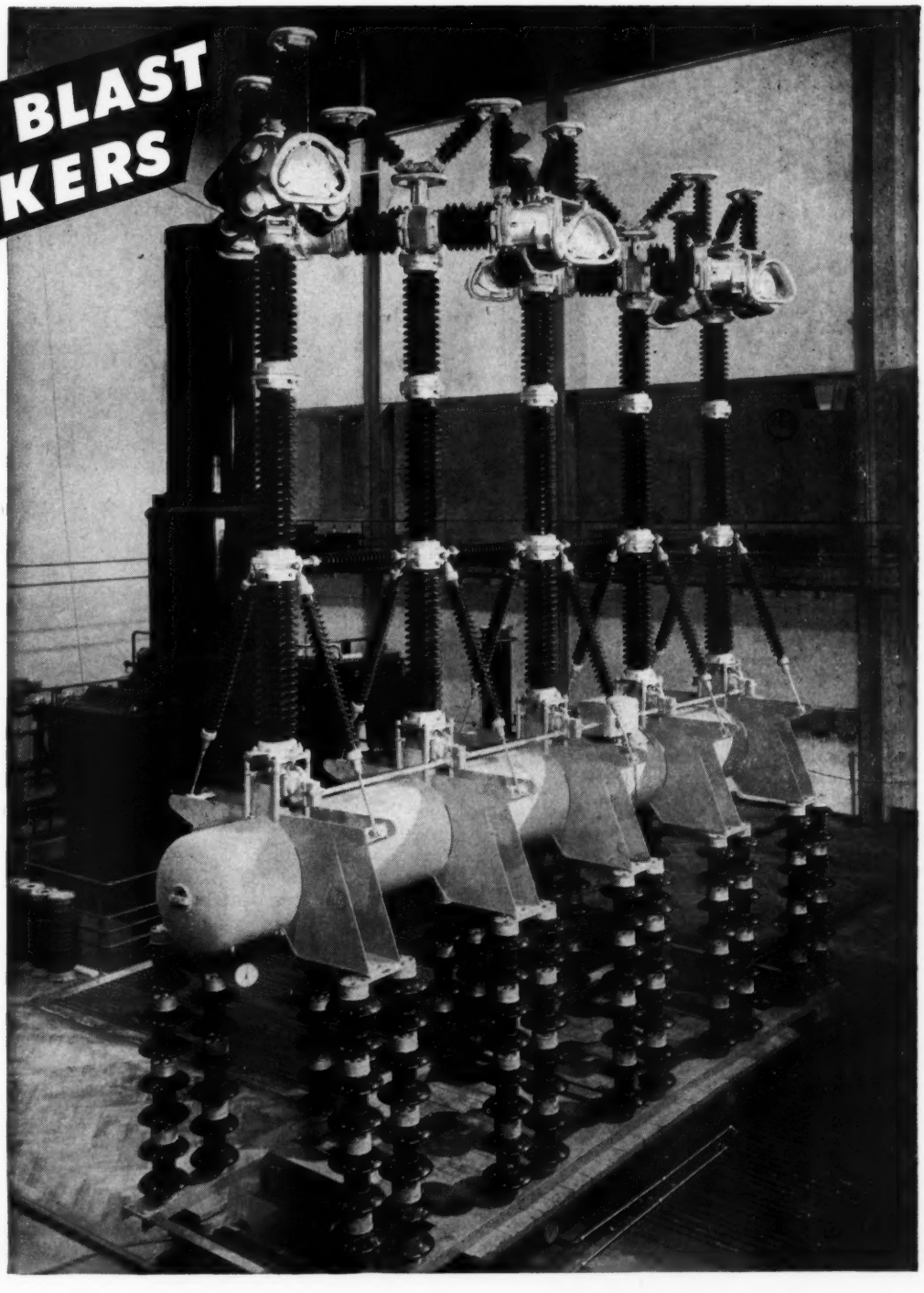

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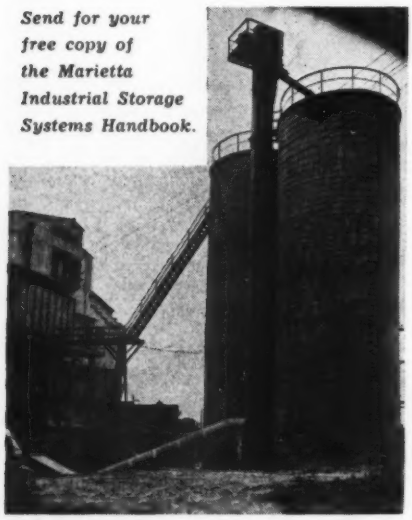

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TRAFFIC ENGINEERING, by Theodore M. Matson, Wilbur S. Smith, and Frederick W. Hurd; McGraw-Hill Book Co., Inc.; 647 pp.; $12.50.

The plan and content of this book have grown out of the training program of the Bureau of Highway Traffic at Yale University. It brings together in a single volume general knowledge of the comparatively new field of traffic engineering and explains by simple analysis highway traffic phenomena. It is divided into five sections: Characteristics, Regulations, Control Devices and Aids, Design, and Administration and Planning.

•

ASME HANDBOOK: ENGINEERING TABLES, edited by Jesse Huckert; McGraw-Hill Book Co., Inc.; 704 pp.; $12.00.

This is one of the four volumes comprising the entire ASME Handbook. The tables are arranged in 15 sections, grouped together according to their application to the design of specific parts. The book is sponsored by the Metals Engineering Handbook Board of ASME.

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"Air-Conditioning and Refrigeration Institute Standard 901-55" establishes minimum requirements for design and construction of prefabricated natural-draft and factory-assembled mechanical-draft water-cooling towers for use with air conditioning and refrigeration equipment. It is available free of charge from the Institute at 1346 Connecticut Ave., N. W., Washington 6, D.C.

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ENGINEERING FORMULAS & TABLES; Lefax Publishers; 350 pp.; $2.75.

This data book contains basic formulas, design data, and tables for civil, mechanical, and electrical engineers. Sections include Mathematics, Measures, Materials, Gauges, Screws, Mechanics, Electricity and Magnetism, Hydraulics, Structural Data, Reinforced Concrete, Pipe and Fittings, Steam Tables, and Mathematical Tables. Pocket size.

Expert Witness Reprint

Robin Beach's five articles on "The Engineer as an Expert Witness" are available in a 16-page reprint for $1.00. Please write to: Reader Service Dept., CONSULTING ENGINEER 227 Wayne St., St. Joseph, Mich.

MECHANICAL ENGINEERING PRACTICE, 5th Ed., by Charles F. Shoop and George L. Tuve; McGraw-Hill Book Co., Inc.; 471 pp.; $7.00.

Recent trends, such as the greater use of electrical instruments and transducers and the study of the dynamics of the processes of flow and heat transfer, are incorporated in this fifth edition. Special emphasis is placed on the latest techniques for mechanical measurements, dynamic characteristics of processes, and automatic control. A chapter on "Characteristics of Automatic Controls," co-authored by Lawrence G. Siegel, has been added.

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FIG. 17-28 Cylinder

FIG. 215 Flanged

FIG. E-57 Double Window

FIG. 212 Visibility Welding Neck or Screw

FIG. E-811 Flapper

FIG. E-1810 Rotating Wheel Type

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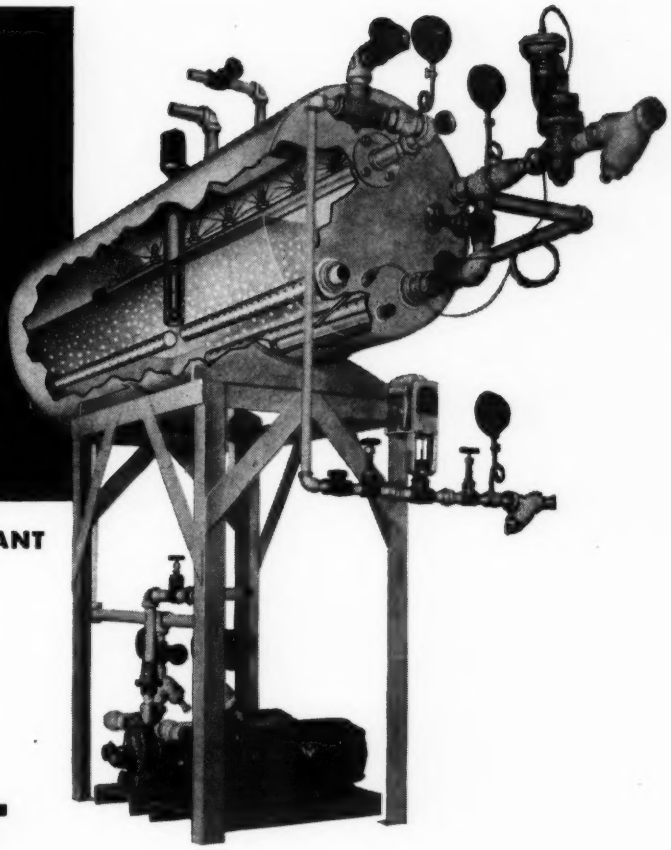

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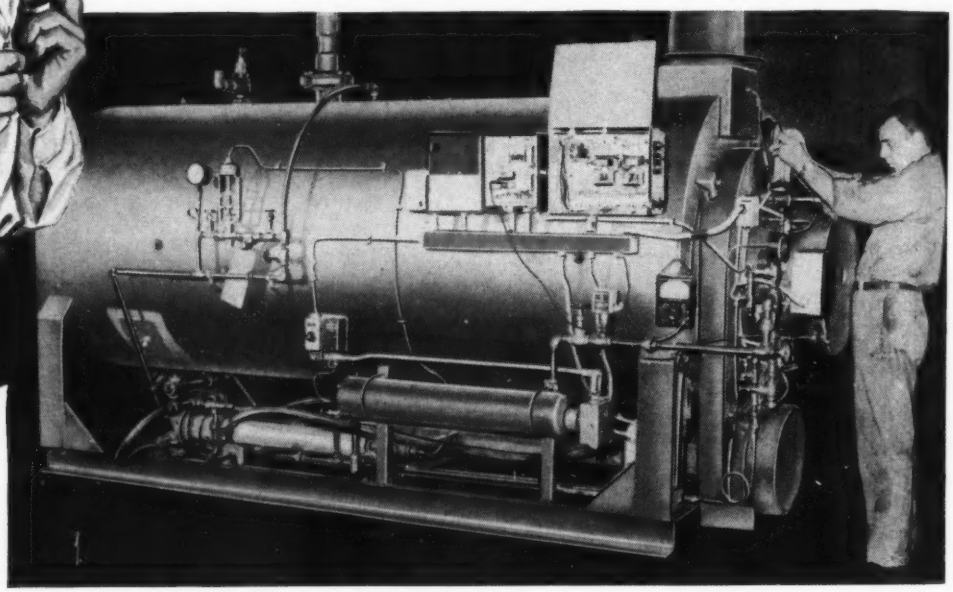

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Date	Sponsor	Event	Location
Sept. 5	American Institute of Consulting Engineers	Monthly Meeting	Engineers' Club New York, N.Y.
Sept. 7	Midwest Research Institute	Problems and Opportunities for the Medium-Size City	Linda Hall Library of Science and Tech. Kansas City, Mo.
Sept. 9-12	American Institute of Chemical Engineers	Meeting	Wm. Penn Hotel Pittsburgh, Pa.
Sept. 10-12	American Society of Mechanical Engineers	Fall Meeting	Cosmopolitan Hotel Denver, Colo.
Sept. 16-22	American Society for Testing Materials	2nd Pacific Area National Meeting and Apparatus Exhibit	Hotel Statler Los Angeles, Calif.
Sept. 17-21	Instrument Society of America	11th Annual Instrument-Automation Conference and Exhibit	N. Y. C. Coliseum New York, N.Y.
Sept. 24-28	Atomic Industrial Forum, Inc.	2nd Annual Trade Fair of the Atomic Industry & Meeting	Morrison Hotel Chicago, Ill.
Sept. 25-28	Association of Iron and Steel Engineers	1956 Iron and Steel Exposition and Convention	Cleveland Public Auditorium Cleveland, Ohio
Oct. 1-3	National Electronics Conference	12th Annual Conference	Hotel Sherman Chicago, Ill.
Oct. 1-5	American Institute of Electrical Engineers	Fall General Meeting	Morrison Hotel Chicago, Ill.
Oct. 9-10	Armour Research Foundation of Illinois Institute of Technology	Conference on Computer Applications	IIT Campus Chicago, Ill.
Oct. 11-12	Armour Research Foundation of Illinois Institute of Technology	National Noise Abatement Symposium	Hotel Sherman Chicago, Ill.
Oct. 18-19	Institute of Management Sciences	3rd Annual International Meeting	Hotel Statler Los Angeles, Calif.
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